ARMY RESEARCH LABORATORY

Joint Base Station Variant 1 MOS-Workload-Skill Requirements Analysis

Frank J. Malkin
Laurel E. Allender
Troy D. Kelley
Pat O'Brien
Steve Graybill

ARL-TR-1441

NOVEMBER 1997

Approved for public release; distribution is unlimited.

ERRATA SHEET

re: ARL-TR-1441, "Joint Base Station Variant 1 MOS-Workload-Skill Requirements Analysis,"
by Frank J. Malkin, Laurel E. Allender, Troy D. Kelley, Pat O'Brien, and Steve Graybill

The following pen-and-ink change should be made in the caption of Table 4 on Page 2:

Workload scales in MANPRINT

should be changed to read

Workload Scales in IMPRINT

Army Research Laboratory
Aberdeen Proving Ground, MD 21005-5425

ARL-TR-1441

November 1997

Joint Base Station Variant 1 MOS-Workload-Skill Requirements Analysis

Frank J. Malkin
Laurel E. Allender
Troy D. Kelley
Human Research & Engineering Directorate, ARL

Pat O'Brien
Steve Graybill
Deputy Chief of Staff Requirements Integration
U.S. Army Special Operations Command

Abstract

The U.S. Army Special Operations Command is developing a replacement communications base station known as the Joint Base Station Variant 1 (JBS V1). The JBS (V1) incorporates an automation subsystem not found in predecessor systems. The introduction of the automation subsystem raised concerns about its impact on the military occupational specialty (MOS) and quantity of base station operators. Task analysis and modeling using the Improved Performance Research Integration Tool (IMPRINT) were conducted to assess skill requirements, workload, and mission performance to assist in determining the appropriate quantity and MOS of JBS (V1) operators. The outcome of the analysis predicts that one Special Forces Communications Sergeant MOS 18E, one Record Telecommunications Operator MOS 74C, and one Information Systems Operator-Analyst MOS 74B are an appropriate skill mix to successfully operate the JBS (V1) during a 12-hour shift. With the implementation of this crew complement plus one 18E supervisor, it would be possible for the Base Station Section of the Special Forces Battalion Signal Detachment to be reduced from the current total number of eight to seven personnel.

ACKNOWLEDGMENTS

Appreciation is expressed to Mr. Bill George, U.S. Special Operations Command, and Mr. John Dade, Naval Air Warfare Center-Aircraft Division, for sponsoring the analysis.

CONTENTS

TABLES

JOINT BASE STATION VARIANT 1
MOS-WORKLOAD-SKILL REQUIREMENTS ANALYSIS

BACKGROUND

The U.S. Army Special Operations Command (USASOC) is developing a transportable base station. This developmental effort is part of a Special Operations Joint Base Station (JBS) umbrella program to build three variations to meet the separate needs of the Army, Navy, and Air Force Special Operations Forces components. The Army variation, referred to as the JBS Variant 1 (V1), is intended to provide continuous long range communications between Army Special Forces Operational Bases and deployed operational detachments.

The technology in the base stations currently used by Army Special Operations Forces is obsolete, resulting in systems that are unreliable, large, and difficult to transport. The current systems are manpower intensive with a propensity for inducing operator errors and are logistically insupportable. Current base stations are not capable of seamless access and interoperability with emerging battlefield digital networks and communications systems as mandated by the U.S. Special Operations Command (USSOCOM) joint C4I architecture.

The JBS (V1) design is intended to provide a modernized capability that will not only provide communications between the Special Forces base station and deployed operational detachments operating in remote locations but will also provide a seamless interface with other communications systems linking the digitized battlefield.

The JBS (V1) vehicular configuration is an integrated system of modular components installed in a communications shelter. The communications shelter is mounted on a fifth wheel trailer with extendable tent shelter and built-in generators. Inside the shelter are radio communications and automation subsystems and ancillary devices that provide secure and nonsecure voice, facsimile, and data communications (see Figure 1). The subsystems can be removed from the shelter racks and be installed in two-man lift transit cases for deployment at semi-permanent locations as shown in Figure 2. The automation subsystem, which does not exist in the currently fielded systems, will enhance the JBS (V1) capability. The automation subsystem provides a password-protected multitasking workstation with full network planning and control functions. It provides a capability to automate the real-time management of seven communication nets and to network the base station with the operational detachments and other units on the digitized battlefield.

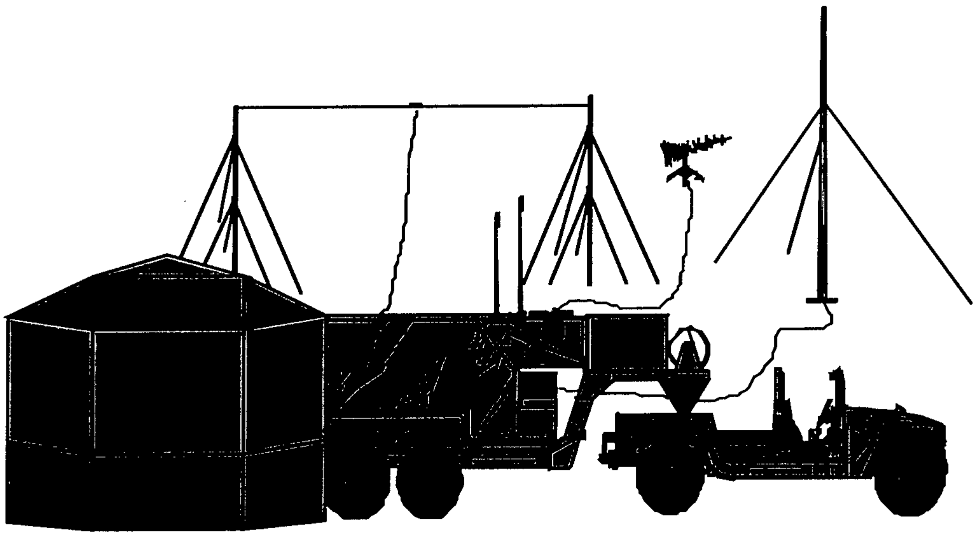


Figure 1. JBS(V1) vehicular configuration.

Figure 2. JBS (V1) transit case configuration.

The incorporation of automation in the design of the JBS (V1) significantly impacts human factors engineering, manpower, personnel, and training considerations. Of immediate concern is whether the automation subsystem and associated network management tasks will require a change in the military occupational specialty (MOS) and quantity of base station

operators. Maintenance personnel are not a concern at this time because sufficient numbers with appropriate skills are believed to be available to maintain the automation subsystem. In response to the concern for the impact on operators, the Program Manager funded the Human Research and Engineering Directorate (HRED) of the U.S. Army Research Laboratory (ARL) to assess operator MOS, workload, and skill requirements for the new system.

PURPOSE

Modeling and analysis were conducted to assess workload and skill requirements to help determine the quantity and MOS of operators for the JBS (V1). This report describes the modeling and analytical process and its outcome.

MANPOWER AND PERSONNEL CONSIDERATIONS

Table 1 shows the current force structure for the base station section of the Special Forces Battalion Signal Detachment. The principal operators of the current base station are the Special Forces Communications Sergeant (SF COMM SGT), 18E and the Record Telecommunications Operator (REC TCC OPR), 74C. The 18E operates all radio communications equipment to transmit and receive radio messages in voice, continuous wave (CW), and burst radio nets including communications security (COMSEC) devices. The 74C performs the record telecommunications and message center functions, including record management, distribution, and preventive maintenance checks and services on the vehicle and power generators. In most situations, the base station is operated 24 hours per day on two 12-hour shifts. One 18E and two 74Cs usually staff the base station. The operators are supervised by the Communications Chief and REC TCC Supervisor.

Neither the 18E nor the 74C has the training or the on-the-job experience to operate the automation subsystem proposed for the JBS (V1). A review of Army MOSs in Army Regulation (AR) 611-201 (Department of the Army, 1995) revealed that a 74B is trained in the standard skills and knowledge required to perform the tasks associated with the automation subsystem (see Appendix A). The 74B, whose job title is Information System Operator-Analyst, operates multi-user information processing systems and performs analyst and system administrator functions.

Table 2 shows a proposed base station section staffing to support the JBS (V1). Because the automation subsystem simplifies or eliminates many 74C tasks, it is proposed that the 74C

E6 and E5 positions found previously in the base station section be eliminated and replaced by two 74Bs. Because of the reduction in the number of 74C positions, it is also proposed that the 74C E7 supervisor be eliminated. The previous Communications Chief now becomes the Base Station Section Noncommissioned Officer in Charge (NCOIC). It is envisioned that one 18E, one 74C, and one 74B will operate the JBS (VI) during each 12-hour shift.

Table 1

MOSs for Current Base Station Section

Title	Grade	MOS	Qty
COMMUNICATIONS CHIEF	E7	18E40	1
REC TCC SUPV	E7	74C4S	1
SF COMM SGT	E6	18E30	2
REC TCC SHIFT SUPV	E6	74C3S	1
REC TCC SR OPR	E5	74C2S	1
REC TCC OPR	E4	74C1S	1
REC TCC OPR	E3	74C1S	1
		TOTAL	8

Table 2

Proposed Base Station Section

Title	Grade	MOS	Qty
SECTION NCOIC	E7	18E40	1
COMM SUPERVISOR	E6	18E30	2
REC TCC OPR	E1-4	74C1S	2
INFO SYS OP-ANAL	E1-4	74B1S	2
		TOTAL	7

ANALYTICAL TOOL

The Improved Performance Research Integration Tool (IMPRINT) is a stochastic network modeling tool designed to help assess the interaction of soldier and system performance. IMPRINT is the successor to the Hardware Versus Manpower III (HARDMAN III) suite of nine separate tools. In IMPRINT, all nine HARDMAN III tools are integrated in a Windows environment. Both IMPRINT and HARDMAN III are Army-owned software products developed by ARL. The portions of IMPRINT used on the JBS (V1) study (task network modeling, workload analysis, and personnel characteristics analysis) were verified, validated, and accredited (VV&A) in January 1995 (Allender et al., 1995).

In IMPRINT, task analysis is used as a starting point to assess the interaction of soldier and system performance. The basic task analysis is used to construct a network that represents the flow of activity during a mission. The network consists of the functions and tasks required to operate or maintain the system. Each network can include multiple simultaneous networks, nested networks, and probabilistic branching logic. The JBS (V1) task analysis and networks are described in the next section, Model Development.

When the model is run, time and accuracy performance data for the individual tasks are aggregated to provide an estimate of system-level performance. One advantage of IMPRINT is that it allows the model to be run a number of times; each run represents a different sample of performance data. Results from the simulation model are reported in terms of mission, function, and task time and accuracy. The results can be compared to any pre-determined criteria in order to examine whether results were within the accepted levels of performance.

In addition to the time and accuracy information, estimates of workload can be associated with each task. When the model is run, the task workload is tallied. In this way, a mission workload profile for each crew member is generated so that workload distribution, peaks, and valleys can be examined.

Also, using embedded algorithms, IMPRINT enables the modeling of various effects such as personnel characteristics (e.g., aptitudes, skill levels) and frequency of training (i.e., sustainment training) on task and function performance and on overall system performance. When selected, the algorithms adjust the expected task times and accuracy, with the degree of adjustment depending on the type of task. For example, increasing the Armed Services Vocational Aptitude Battery (AVSAB) aptitude area cutoff score will have a greater effect on a cognitive task (e.g., recall) than on a gross motor task (e.g., button actuation). The analyst can

then conduct performance trade-offs by examining how sensitive mission performance is to changes in levels of personnel characteristics, training frequency, and so forth.

For JBS (V1), IMPRINT was used to assist in determining if a crew of three (one 18E, one 74C, and one 74B) could successfully operate the proposed base station during a 12-hour shift. Task, function, mission performance, crew workload, and the effects of personnel characteristics were examined.

MODEL DEVELOPMENT

The initial step in using IMPRINT is to develop a model representing system operation and performance. JBS system operation consists of four mission segments: "setup," programming, operation, and "tear-down." Each mission segment further consists of functions and tasks as shown in Table 3. The combat developer and program manager determined that one function in each of the setup and tear-down missions (transit case setup and tear-down) and two of the functions within the operation mission segment (transit case mode and automated mode) need not be modeled. The transit case functions were not modeled because operation in the transit case mode is not significantly different from shelter operation and transit case setup and tear-down were not of priority concern at this time. The automated mode of operation was not modeled because, in this mode, some 74C tasks are not performed. In order to assess "worst case" workload, only system operation in the manual mode was modeled.

Special Forces soldiers experienced in base station operations assisted in developing function and task flow diagrams (see Appendix B) and provided performance data for the model by assigning estimated time, accuracy, and workload to each task. All performance data were estimated with the assumption that tasks were performed by average soldiers who were trained and experienced with the system. The time, accuracy, and workload data assigned to each task are shown in Appendix C.

The first step in estimating performance data was to assign operators to tasks. The 18E, 74C, or 74B, as applicable, was assigned responsibility for performing a task. When necessary, as in the task of "setting up" the tent extension, multiple operators were assigned to a task. The 74B is a relatively new MOS and is not yet included in the IMPRINT database; however, the predecessor MOS, the 74F MOS, is. Because all critical data (i.e., AVSAB area and cutoff score) for the two MOSs are the same from an IMPRINT perspective, the decision was made to run the model using the 74F but to use 74B label.

Table 3

Functions and Tasks for the Four Missions: Setup, Programming, Operations, and Tear-Down

Mission	Functions	Tasks
Setup		
	Shelter setup	Position trailer on site
		Disconnect and level pack horse
		Ground system
		Connect power cables
		"Set up" tent extensions
		Set up camouflage nets
		Run pre-operational checks on ECUs and generator
		"Power up" generator
		Power up ECUs
		Remote terminal equipment into tent
		Perform "powerup" procedures
	General system setup	Perform built-in tests
		Remote and power RCCs
		Erect HF antenna #1
		Erect HF antenna #2
		Erect HF antenna #3
		Erect HF antenna #4
		Erect HF LPI/D antenna
		Erect UHF TACSAT antenna #1
		Erect UHF TACSAT antenna #2
		Erect VHF/FM antenna
		Perform operational checks
	Transit case setup	(not modeled here)
Programming		
	Configure CGS 100	Perform station setup
		Create a configuration set
		Select routing methods
		Select and configure routing devices
		Create RI routing tables
		Create PLA/RI database
		Set up networking
		Create user accounts
		Select mode of operation
	Configure audio monitoring	Select audio or data mode
		Program RCC number
		Enable or disable intercom
		Configure RCC data port
	Program radio parameters	Program HF radios
		Program SINCGARS radio
		Program UHF TACSAT radio
		Program HF LPI/D system
	Program automatic data controller	Configure input-output directories
		Select configuration parameters

Table 3 (continued)

Operations	Checks/services	Perform PMCS shelter Perform PMCS ECU and generators Perform PMCS on communications equipment Perform PMCS packhorse trailer Perform PMCS on automation
	Radio communications	Monitor power Listen for incoming voice Listen for incoming IMC traffic Respond to incoming voice Route incoming voice traffic Initiate voice call to ODA Recognize incoming IMC traffic Copy incoming IMC traffic Identification Isolation Resolution
	Message center	Monitor incoming message traffic Print incoming message traffic Make disk copy of incoming Place incoming message traffic into distribution Log outgoing message Load message into PC
	Automation and network management	"Back up" and log files Add new addresses Establish user privileges Change (establish) user privileges Automation identification Automation isolation Automation resolution
	Transit case mode	(not modeled here)
	Automated mode	(not modeled here)
Tear-Down	General system tear-down	"Zeroize" (i.e., remove or eliminate the communications security key from a crypto device or other COMSEC equipment) COMSEC equipment, as required Print log,archive; as required "Power down" system,subsystems Power down ECU and generator Disconnect antenna, power cables Disassemble, stow antennas Disconnect, package RCCs
	Shelter tear-down	Disconnect, stow terminal equipment Dismantle camouflage nets Dismantle tent extensions Disconnect power cables Remove, package grounding Reconnect packhorse
	Transit case tear-down	(not modeled here)

CGS = Communications Gateway System
COMSEC = communications security
ECU = environmental control system
HF = high frequency
IMC = international Morse Code
LPI/D = low probability of interception/detection
ODA = Operational Detachment "A"
PC = personal computer
PLA/RI = plain language addresses/routing indicators
PMCS = preventive maintenance checks and services
RCC = remote control console
SINCGARS = single channel ground and airborne radio system
TACSAT = tactical satellite
UHF = ultra high frequency
VHF/FM = very high frequency/frequency modulation

The average or mean time to perform each task and an associated standard deviation were assigned. The standard deviation is used in IMPRINT to generate a distribution of performance times that includes the fastest and slowest possible times. The mean accuracy and an associated standard deviation were also provided for each task. The mean accuracy and standard deviation are related to the difficulty and complexity of a task, with the standard deviation being used to generate a distribution of highest and lowest expected accuracy. For example, the average accuracy with which a fault in the automation subsystem can be detected is 97% with a standard deviation of 1%, but the average accuracy to identify the cause of the fault is 90% with a standard deviation of 3%.

In addition to the accuracy mean and standard deviation, an accuracy standard was also provided for each task. The accuracy standard is expressed in percent and is the lowest acceptable level at which a task can be performed without having some negative consequence. A consequence of unacceptable performance could range from having to repeat the task to causing a mission failure, as the case may be. Accuracy standards were assigned on the basis of how critical the task is to mission success. For example, the standard for the task of "powering up" the generator is 100%. If the generator is not operational, the base station is totally inoperable. The standard for positioning the trailer, however, is only 50% because the position of the trailer is not critical to successful system operation.

Using these three pieces of information (accuracy mean, standard, and standard deviation), a probability of success is generated for each task. Basically, the probability of success is the likelihood that the accuracy standard can be achieved. If the standard is higher than the accuracy mean, the probability of success will be low; and if the standard is lower than the mean, the probability of success will be high. As a result, the probability of success for starting the generator is virtually 100% because it is a simple on-off switch operation, and average accuracy performance is high. On the other hand, the probability of success for isolating or identifying the cause of a fault in the automation subsystem, which is more difficult, is only about 90%.

Workload estimates were assigned to each task using the rating scales shown in Table 4.

In order to run the operations mission segment of the model, branching probabilities were assigned to the parallel tasks within the radio communications, message center, and automation and network management functions. The branching probability was used to control the frequency with which the model would run through each path and was assigned based on how often tasks occur during typical base station operations.

Table 4

Workload Scales in IMPRINT

Scale value	Descriptors
	Visual
1.0	Visually register/detect (detect occurrence of image)
3.7	Visually discriminate (detect visual differences)
4.0	Visually inspect/check (discrete inspection/static condition)
5.0	Visually locate/align (selective orientation)
5.4	Visually track/follow (maintain orientation)
5.9	Visually read (symbol)
7.0	Visually scan/search/monitor (continuous/serial inspection, multiple conditions)
	Auditory
1.0	Detect/register sound (detect occurrence of sound)
2.0	Orient to sound (general orientation/attention)
4.2	Orient to sound (selective orientation/attention)
4.3	Verify auditory feedback (detect occurrence of anticipated sound)
4.9	Interpret semantic content (speech)
6.6	Discriminate sound characteristics (detect auditory differences)
7.0	Interpret sound patterns (pulse rates, etc.)
	Cognitive
1.0	Automatic (simple association)
1.2	Sign/signal recognition
3.7	Alternative selection
4.6	Encoding/decoding, recall
5.3	Formulation of plans (projecting action sequence, etc.)
6.8	Evaluation (consider several aspects in reaching judgment)
7.0	Estimation, calculation, conversion
	Psychomotor
1.0	Speech
2.2	Discrete actuation (button, toggle, trigger)
2.6	Continuous adjustive (flight control, sensor control)
4.6	Manipulative
5.8	Discrete adjustive (rotary, vertical thumbwheel, lever position)
6.5	Symbolic production (writing)
7.0	Serial discrete manipulation (keyboard entries)

MODEL ASSUMPTIONS

The following conditions were established while developing the model and setting prerequisites for running the model.

1. A 12-hour shift was modeled.

2. Radio and message traffic was evenly distributed over the 12-hour shift. Although peaks and lulls in communications are more realistic, an even distribution was viewed by the Special Forces subject matter experts (SMEs) to be acceptable for the purpose of this analysis.

3. No time constraints were placed on the completion of tasks. The only system requirement is that the JBS be established within 21 man-hours.

MODEL OUTPUT

Once each task network was fully developed and all the required task data were entered, each of the mission segment models was executed from 10 to 500 times in order to obtain representative sampling of task time, accuracy, and workload data. The setup, programming, and tear-down mission segment models were run 500 times each. Since the operations mission segment model was structured so that individual tasks repeated a large number of times, it was run only 10 times. The outcome of these mission replications is as follows.

Overall Mission Segment Time

The average predicted time for each mission segment is shown in Table 5. Note that since the operations mission segment was modeled as a 12-hour shift and the model did not allow tasks to be started that could not be completed during the shift, the missions never ran longer than 12 hours.

Table 5

Average Predicted Mission Time in Hours and Minutes

Mission	Average predicted time
Setup	3:48
Programming	3:32
Operations	11:47
Tear-Down	2:46

The only time constraint established in the Operational Requirements Document (ORD) for the JBS (V1) system is that it be capable of setup within a total of 21 man-hours. The predicted setup time achieved using the three-person crew is well within the 21-man-hour time constraint.

Since all the models include task time and accuracy variability, ranges of predicted times were obtained for all the mission segments. The range for the operations mission segment is small, of course, because of the 12-hour shift constraint. The ranges are also small for the setup and tear-down mission segments; however, for the programming mission segment, there is quite a wide range of times. The programming times vary from a minimum of 2 hours and 44 minutes to a maximum of 4 hours and 40 minutes. The shortest time represents the fastest and most accurate performance possible, and the longest time represents a possible "worst case," with many of the tasks having to be repeated because they were not performed accurately enough.

Operations Activity

The average frequency with which tasks occur during the operations mission segment for a 12-hour shift (based on 10 model runs) is as follows:

Incoming voice communications	101.1
Outgoing voice communications	34.1
Incoming international Morse code (IMC)	1.3
Incoming digital messages	24.00
Outgoing digital messages	38.00
Troubleshooting	1.5
Adding new addresses or changing user privileges	3.6

The frequency of tasks shown here is an outcome resulting from the probability of occurrence assigned to the functions and tasks branches of the operations mission segment. In the opinion of the Special Forces SMEs, this represents a fairly realistic level of activity for a typical base station.

Workload

Workload for all the mission segments appears to be manageable. Overall workload for each task was calculated by adding the four individual workload scale ratings. The overall task workload for each of the three MOSs across each of the four missions segments is shown in Figures 3 through 6. During setup, work activity for the 18E is constant throughout erecting the shelter and system antennas. Work activity for the 74C is fairly constant, with some lulls while the 18E is grounding the equipment, and so forth. The 74B participates early in erecting the shelter but then has no further tasks. During programming, the 74B works constantly throughout

the mission segment, whereas the 18E works steadily until about the last 20 minutes when workload stops completely. This may point to a potential for task reallocation to reduce programming time.

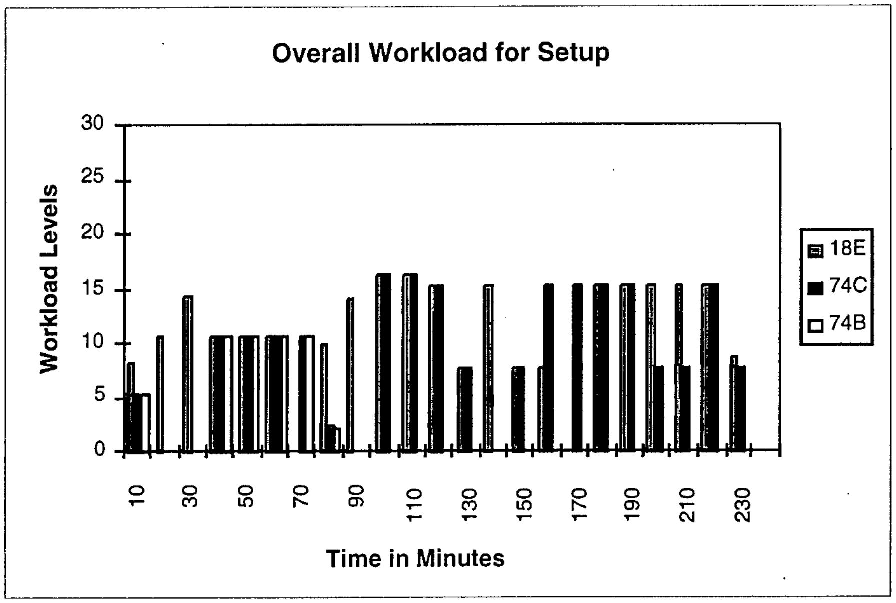


Figure 3. Overall workload for the setup mission segment.

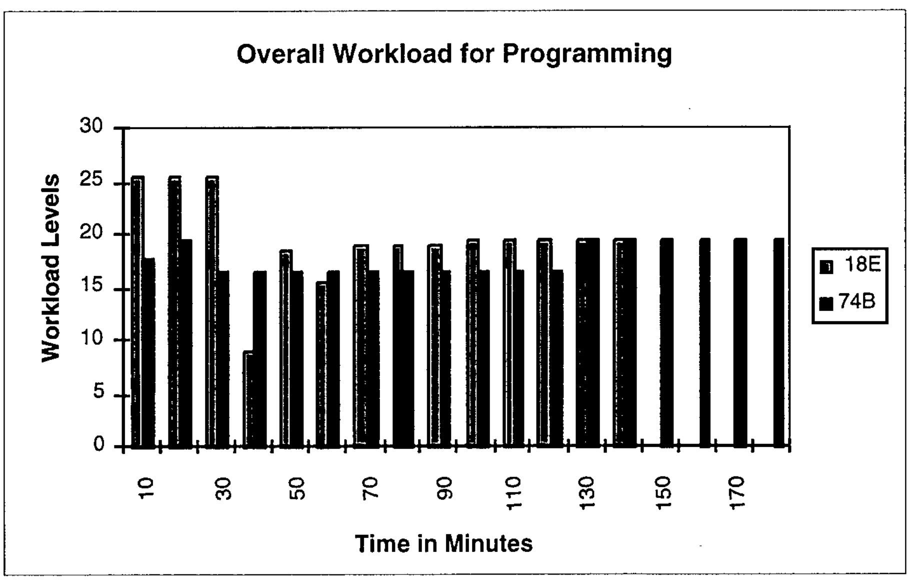


Figure 4. Overall workload for the programming mission segment.

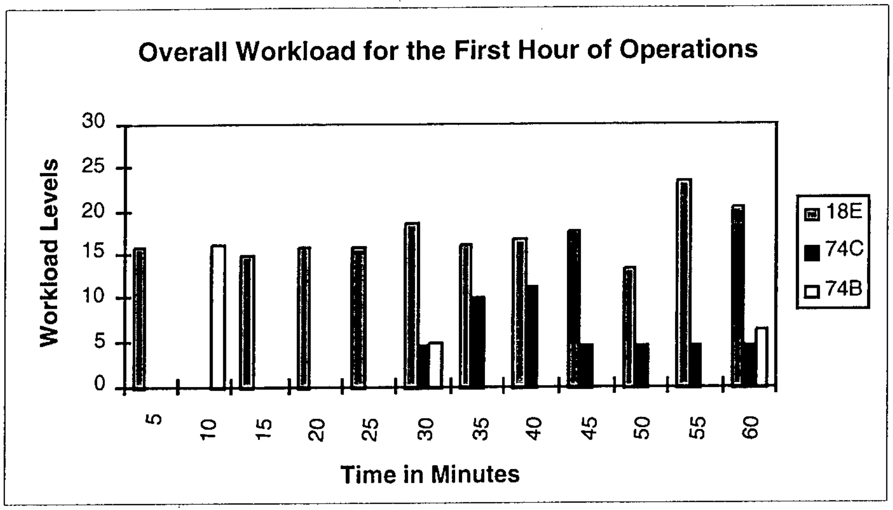


Figure 5. Workload for a "slice" of the operations mission segment.

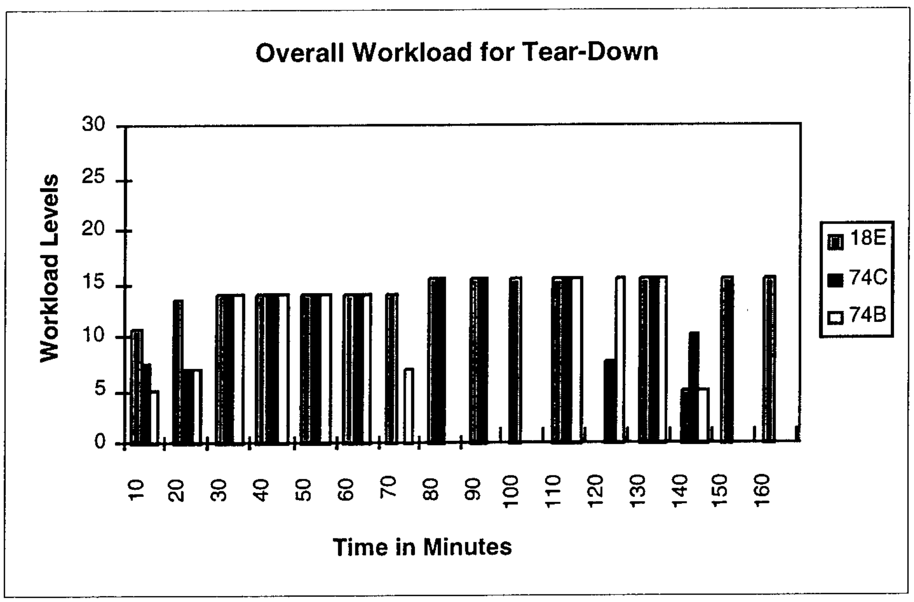


Figure 6. Overall workload for the tear-down mission segment.

Since tasks repeat many times throughout the operations mission segment, a representative "slice" that includes the initial preventive maintenance, checks, and services and the first system "backup," was selected for the workload evaluation. The 18E is busy throughout because radio communications are the predominant activity. On the other hand, the 74C and 74B experience peaks and valleys. Workload is fairly evenly distributed during tear-down.

Looking at the workload at a more detailed level for the programming and operations missions sheds some light on what types of tasks are driving the workload for the different JBS (V1) crew positions (see Figures 7 through 10). The task workload ratings were graphed for each of the individual scales: visual, auditory, cognitive, and psychomotor. The workload on each scale run from 0 to 7. If one task is performed at a time, the maximum workload on each scale is 7; however, if more than one task is performed at a time, then the workload values for the tasks are added and could be greater than 7.

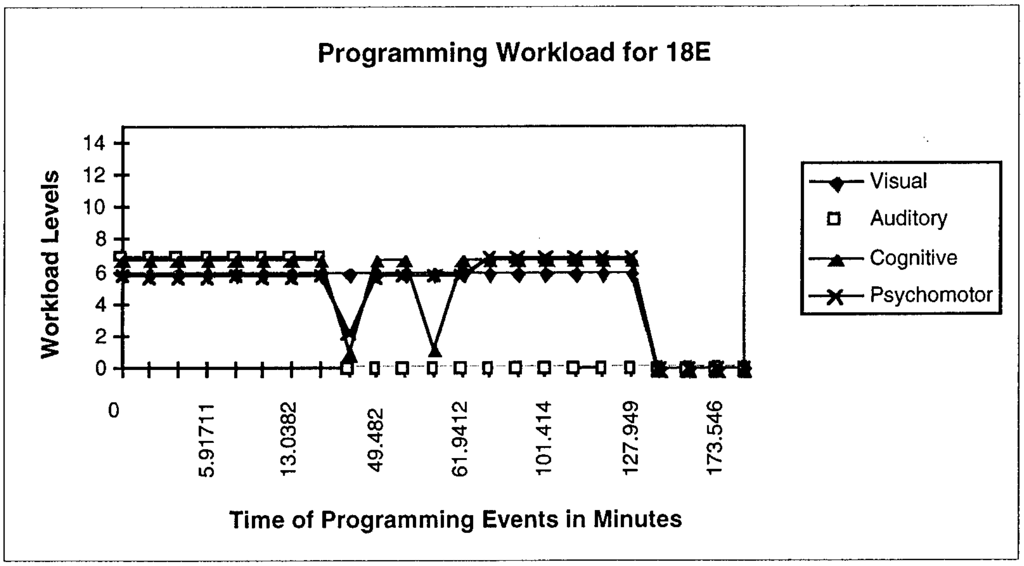


Figure 7. Detailed workload profile for 18E for programming.

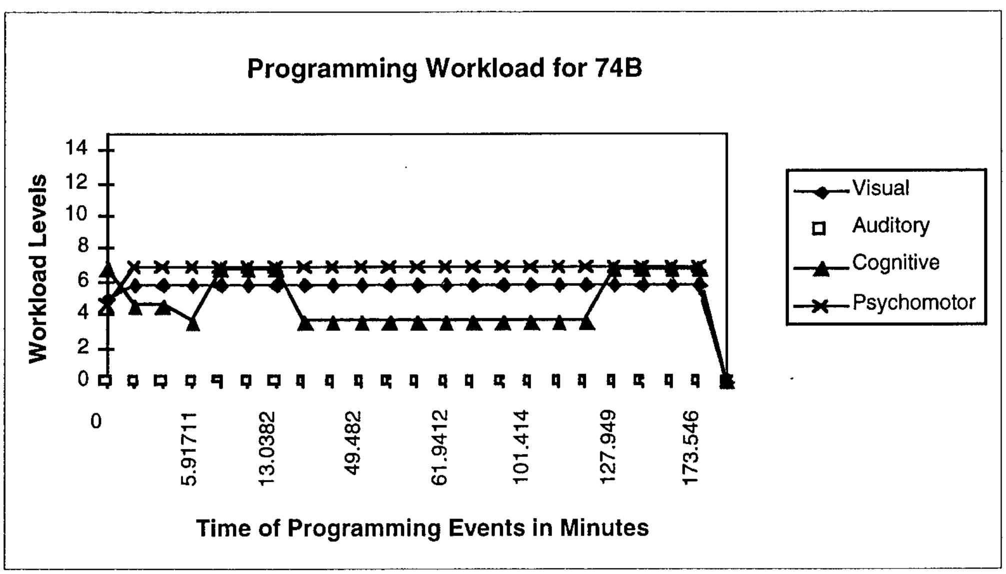


Figure 8. Detailed workload profile for 74B for programming.

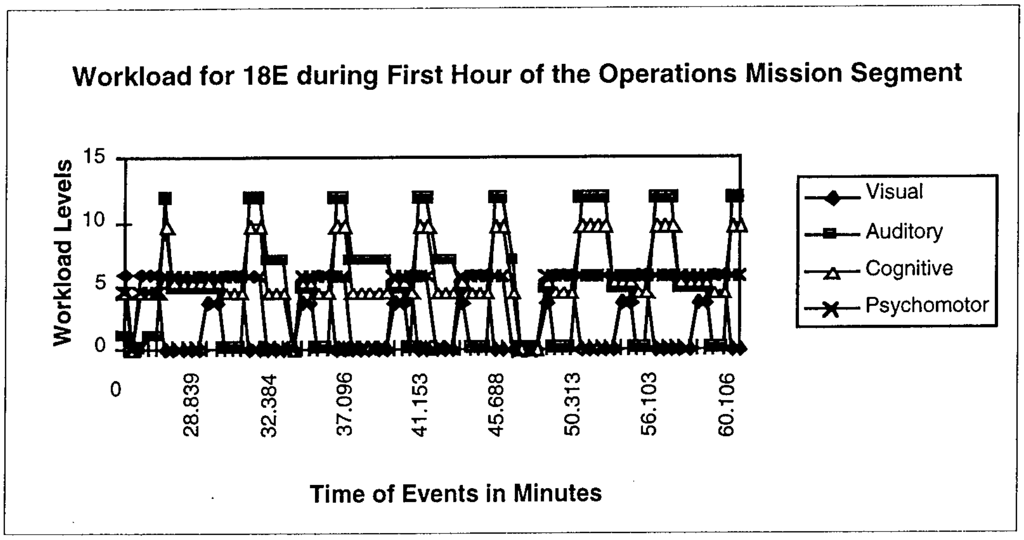


Figure 9. Detailed workload profile for 18E for operations.

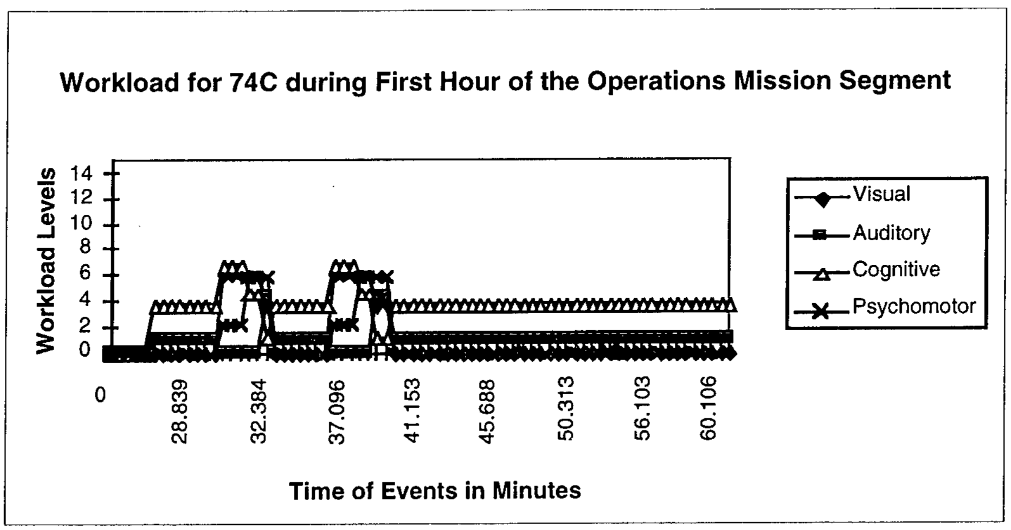


Figure 10. Detailed workload profile for 74C for operations.

For the programming mission, the workload profiles for the 18E and the 74B are generally similar (see Figures 7 and 8). The maximum workload is 7. Since, during the programming mission, the crew members do not perform more than one task at a time, the profiles show that certain individual tasks are quite demanding. The visual, cognitive, and psychomotor profiles are similar, although the 18E does perform a few tasks, such as selecting audio or data mode on the audio equipment, which entail mainly visual workload. The tasks performed by two MOSs do differ markedly on the auditory profile, however. The 74B tasks do not have any auditory

component at all, whereas the 18E tasks performed on the COMSEC equipment have an auditory workload component.

The detailed workload profiles for the three crew members for the first hour of the operations mission segment are shown in Figures 9 through 11. (Note that the times on the horizontal axis are not uniform but instead represent when events or tasks occurred.) A great difference can be seen across the three profiles. The 18E is busy throughout the mission, with frequent high peaks in auditory and cognitive workload and frequent moderate peaks in visual and psychomotor workload. This is probably a reasonable representation of the 18E workload since the JBS (V1) will still have a predominance of radio communications.

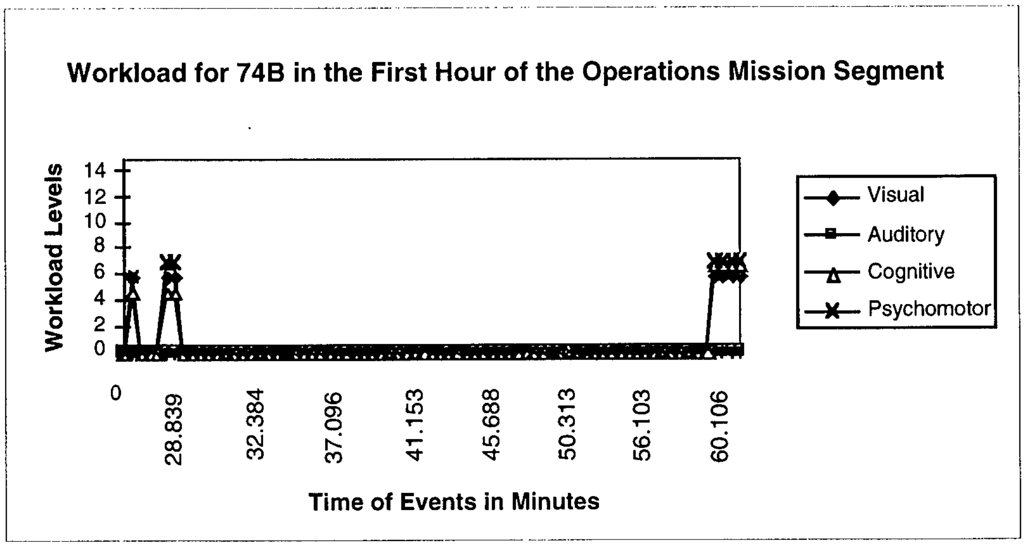


Figure 11. Detailed workload profile for 74B for operations.

The 74C operations workload profile is marked by fairly constant but moderate cognitive activity, with periodic peaks of activity in the visual, cognitive, and psychomotor areas. The 74B has peaks of workload when performing the system backups and then later when adding or updating user addresses, but these tasks are sporadic rather than constant. The 74B does not perform the constant vigilance-type tasks such as the monitoring tasks performed by the 18E and 74C. Also, in the way operations are modeled here, neither the 74C or the 74B ever has a workload as high as that experienced by the 18E, who often is performing two or three tasks at a time as can be seen by workload values in the 10 to 13 range.

In summary, the workload profiles for all the mission segments provide descriptions of the overall workload requirements of the tasks and also of the timing of the tasks. The detailed

profiles provide a "breakdown" of workload as a function of the individual dimensions--visual, auditory, cognitive, and psychomotor. The profiles allow the tasks and combinations of tasks of the JBS (V1) crew members who contribute the most to workload to be identified. Also, potential for task reallocation can be identified.

Task Accuracy

In addition to the mission time data and the workload profiles, a closer inspection of the underlying task accuracy performance is informative. The nature and structure of the tasks performed in the JBS (V1) are such that the most likely consequence of an error is that the error will be detected and the task repeated until completed successfully. The primary effect of errors, then, is that task times are lengthened. Although accuracy is important for all JBS (V1) missions, for the purposes of this analysis, only the programming and the operations mission tasks were examined for accuracy.

For the programming mission, each task is performed just once. Therefore, if performance were "perfect," that is, if no tasks had to be repeated to compensate for inaccurate performance, then there would be no task repetitions. The percentage of times a task had to be repeated, (i.e., the error rate) was calculated for each task and averaged for each of the two MOSs who perform the programming mission. The average task error rates are shown in Table 6.

Table 6

Average Programming Error Rates for the Two MOSs

MOS	Error rate (percent)
18E	2.16
74B	2.82

This level of performance is certainly within an acceptable level and indicates that some checking and repetition of programming tasks are expected.

For the operations mission, task performance accuracy and error rate were assessed differently than for the programming mission. This is because the operations mission called for a large number of repetitions for most tasks, for example, monitoring for incoming calls or initiating

an outgoing call. Therefore, when reviewing the model output, a task repetition could either be because of sub-optimal performance or because it was simply time to perform the task again. Therefore, for the operations mission, error rate was assessed by directly tabulating the percentage of occurrences that were performed at a sub-optimal level. These figures were averaged across tasks for each of the three MOSs and are shown in Table 7.

Table 7

Average Operations Error Rates for the Three MOSs

MOS	Error rate (percent)
18E	6.37
74B	6.35
74C	2.45

These numbers show that the error rate was slightly higher for the 74B and 18E than for the 74C. This reflects on the difficulty and complexity of the 74B and 18E tasks compared to those of the 74C and therefore, on the need for higher skill levels and training required for those two MOSs.

MOS and Personnel Characteristics

To better understand the suitability of the 74B MOS being proposed for the JBS (V1), additional models runs were completed. In IMPRINT, the baseline model is considered to be the average performance expected as a function of an MOS's abilities and the MOS-specific training received. In order to assess the potential impact of another MOS performing the tasks assigned to the original MOS, the ASVAB aptitude area and cutoff score used for selection into the original MOS are changed to match those of the other MOS. IMPRINT then adjusts the average task performance time and accuracy, based on the changes in personnel characteristics when going from one MOS to the other MOS.

For each of the programming and operations missions, two additional models were run: one with the 74B tasks assigned to the 18E and one with the 74B tasks assigned to the 74C. No additional models were run for the setup and tear-down missions because the 74B tasks were

essentially manual tasks such as erect camouflage nets, which were already performed by the other two MOSs in the JBS (V1) crew.

The current ASVAB cutoffs for the MOSs in the model are shown in Table 8. (Although the 74B is not in the IMPRINT library, the predecessor MOS, the 74F, has the identical ASVAB area and cutoff score.) A cutoff score of 100 is equivalent to an Armed Forces Qualification Test (AFQT) Category II soldier and a cutoff score of 90 is equivalent to an AFQT Category IIIB soldier.

Table 8

ASVAB Aptitude Area and Cutoff Scores for the Three MOSs Modeled
(SC = surveillance and communication, EL = electronic, ST = skilled technical)

MOS	ASVAB aptitude area	Cutoff
18E	SC	100
74B	ST	100
74C	EL	90

For the programming mission, the 74B performs three functions, configure CGS 100, configure matrix switch, and program automatic data controller, which together comprise 11 separate tasks. When those tasks were re-assigned to the 18E, the model predicted overall performance to be at the same level as when the tasks were assigned to the 74B; however, when those tasks were assigned to the 74C, performance worsened.

The function-level results for the three MOSs are shown in Table 9. (Data for the 18E and 74B are combined because the model predicted no difference.) When performed by the 74C, the configure CGS 100 function took only slightly longer on average (about 1%) but was also more variable. The range between the minimum and maximum times was about 10 minutes greater with the 74C than the 74B, or an increase of about 9% between the fastest possible time to perform the function and the longest. The range for the configure matrix switch function was also greater when performed by the 74C. Surprisingly, the model predicted a slight decrease in range for the program automatic data controller function, although the actual difference is small (only 2 minutes).

Table 9

Average or Mean Performance Times and Ranges for the Programming Functions for the 74B and for the 18E and 74C when Performing 74B Tasks

Programming functions	74B & 18E Mean time	74B & 18E Range	74C Mean time	74C Range
Configure CGS 100	3:10	1:56	3:12	2:06
Configure matrix switch	0:02	0:01	0:02	0:04
Program automatic data controller	0:20	0:21	0:20	0:19

*Data for the 18E and 74B are combined because the model predicted no difference.
Times are in hours and minutes

For the operations mission, when the 18E and 74C are substituted for the 74B, there is a small effect on the time to complete individual tasks that are performed during the 12-hour shift. Compared to the 74B, averaged across all the tasks, the 18E is about 0.5% faster and the 74C is about 1% slower. This effect is consistent but probably is not operationally significant.

With respect to error rates for the operations mission, when compared to the 74B, the 18E had a slightly lower error rate and the 74C had a slightly higher error rate as shown in Table 10. The error rates on the individual tasks are also shown in Table 10. The model predicted that compared to the 74B, the 18E would have a higher error rate on half the tasks and a lower rate on half. The 74C, on the other hand, had a higher rate on all but one task.

As with the programming model predictions, the predictions for the operations tasks show a consistent trend in the relative performance of the three MOSs. This outcome indicates that the personnel characteristics and level of AVSAB aptitude area cutoff scores for the 74B and 18E result in a comparable level of performance. The personnel characteristics and level of AVSAB aptitude area cutoff score for the 74C result in a slightly lower level of performance.

Table 10

Operations Mission Error Rates for the Overall Mission and for Specific Tasks for the 74B and for the 18E and 74C when Performing 74B Tasks

	Error rate		
	74B	18E	74C
Overall operations performance	6.35*	5.40	7.36
Operations tasks			
Perform backup & log	14.00	13.50	16.50
Add new addresses	1.95	2.90	2.12
Establish/change user privileges	4.30	4.54	6.38
Fault identification	2.60	1.84	5.39
Fault isolation	14.68	15.00	16.30
Fault resolution	2.60	0.84	1.62

*From Table 7

SUMMARY AND CONCLUSIONS

An automation subsystem is incorporated in the JBS (V1) to enhance its capability. Because the automation subsystem does not exist in currently fielded base stations, a concern was raised regarding its impact on the MOS and quantity of current base station operators. A cursory analysis of the automation subsystem tasks revealed that neither the Special Forces Communications Sergeant, MOS 18E nor the Record Telecommunications Operator, MOS 74C, who operate current base stations, has the necessary training and experience to successfully perform the required automation and network management tasks. A review of Army MOSs indicated that an Information Systems Operator-Maintainer, MOS 74B, possesses the training and qualifications to perform these tasks. Because automation simplifies or eliminates some current 74C tasks, it was proposed that one 18E, one 74C, and one 74B be included in the crew of the JBS (V1) during each 12-hour shift in lieu of one 18E and two 74Cs who operate current base stations.

IMPRINT modeling was used to assist in determining if a three-person crew consisting of one 18E, one 74C, and one 74B is an appropriate crew complement to successfully operate the JBS (V1) during a 12-hour shift. The model examined performance by each MOS position in terms of task times and accuracy. Accuracy performance, as an indicator of task complexity, was further used to assist in assessing the requirement for a 74B to perform the automation and network management tasks. IMPRINT modeling also examined the task workload for each crew

position which assisted in assessing the appropriate quantity of operators. The model aggregated the task level data to provide system level mission performance.

The model outcomes for time, accuracy, workload, and overall mission performance predict that one 18E, one 74C, and one 74B can successfully operate the JBS (V1) during a 12-hour shift. The model predictions indicated that the work can be accomplished within expected time frames and that workload was at a fairly reasonable level, although some peaks and valleys could be examined more closely. Also, the level of complexity of some of the automation tasks supports the need for a crew member with 74B aptitude, skills, and most importantly, training and experience. While the other MOSs may have some of the underlying aptitude or skills, they currently do not receive any of the type of training that would be required. In summary then, this modeling effort supports the proposed modification of the base station section of the Special Forces Battalion Signal Detachment which now would consist of one 18E supervisor, two 18Es, two 74Cs, and two 74Bs.

RECOMMENDATIONS

The workload profiles point to some potential task reallocations among operators, which could possibly reduce function times or result in more evenly distributed workload. Of course, any task reallocations would have to be supported by appropriate cross training. It may be useful to closely examine the workload profiles to assist in developing JBS (V1) operating procedures.

An important aspect of fielding the JBS (V1) is the identification of training needs. IMPRINT can be used to model the effects of frequency of training on task performance and to identify tasks that would benefit highly from sustainment training.

REFERENCES

Allender, L., Kelley, T.D., Salvi, L., Lockett, J., Headley, D. B., Promisel, D., Mitchell, D., Richer, C., & Feng, T. (1995). Verification, validation, and accreditation of a soldier-system modeling tool. Proceedings of the Human Factors and Ergonomics Society 29th Annual Meeting-1995, San Diego, pp. 1219-1223.

Department of the Army (26 June 1995). Enlisted career management fields and military occupational specialties (AR 611-201). Washington, DC: Author.

Preceding Page Blank

APPENDIX A

INFORMATION SYSTEMS OPERATOR-ANALYST AR 611-201 SKILLS AND KNOWLEDGE

Table 2-73Z-3
Standards of grade TDA—Continued

Line	Duty position	Code	Grade	Explanatory notes
5	Sr finance insp NCO	73Z50	SGM	Fld Acty of Hq USAREUR.
6	Sr res mgt ops NCO	73Z50	SGM	1. DCSRM of MACOM with Mob Msn. 2. RMO of Fort Bragg. 3. Fin and Acctg Div in Hq of 3rd Army.
7	Sr finance ops NCO	73Z50	SGM	1. Following elements of USAFAC: a. Fin Network Qual Dir. b. Fin and Acctg Plans Ofc. 2. USAG FAO of Forts McPherson, MDW and Panama. 3. Fin and Acctg Div in Tng Ctr of Forts Benning, Bliss, Dix, Knox, and Leonard Wood. 4. Fin Sys Gp of Joint Planning Spt Agcy.
8	Chief fin corps NCO	73Z50	SGM	As principal NCO in Fin Sch of Fort Ben Harrison.

2-209. 74B—Information Systems Operator-Analyst (Info Sys Opr-Analyst), CMF 74

a. Major duties. Information systems operator-analyst supervises, installs, operates and performs unit level maintenance on multi-functional/multi-user information processing systems, peripheral equipment, and associated devices in mobile and fixed facilities; performs analyst functions; constructs, edits, and tests computer system programs; conducts data system studies and prepares documentation and specifications for proposals; operates and performs Preventive Maintenance Checks and Services (PMCS) on assigned vehicles and power generators. Duties for MOS 74B at each level of skill are:

(1) *MOSC 74B1O.* Installs, operates, and performs unit maintenance on multi- functional/multi-user information processing systems and peripheral equipment and auxiliary devices. Performs input/output data control and bulk data storage operations. Transfers data between information processing equipment and systems. Troubleshoots automation equipment and systems to the degree required for isolation of malfunctions to specific hardware or software. Restores equipment to operation by replacement of line replaceable unit (LRU). Installs, operates, performs strapping, restrapping, PMCS and unit level maintenance on COMSEC devices. Assists in the design, preparation, editing, and testing of computer programs. Drafts associated technical documentation for program reference and maintenance purposes. Modifies existing application packages using application and operating system software and appropriate computer language commands and files.

(2) *MOSC 74B2O.* Configures information processing equipment into required operating configurations. Performs senior operator and systems administrator duties and unit level maintenance functions on assigned computer systems. Compiles production report data and quality control information. Assists less experienced soldiers in the installation, operation, and maintenance of information processing equipment. Writes, analyzes, edits, tests, and modifies computer programs. Drafts program operation manuals and technical program requirements documents. Troubleshoots software using established debugging procedures.

(3) *MOSC 74B3O.* Supervises the deployment, installation, operation, and unit level maintenance of multi-functional/multi-user information processing systems. Determines requirements, assigns duties, and coordinates activities of personnel engaged in information system analysis and maintenance. Develops and administers on-site training programs. Compiles output reports in support of ADPE operations. Performs system studies using established techniques to develop new or revised system applications and programs. Writes final design programs, operational manuals, procedures, and requirements documents. Analyzes telecommunications information management needs. Ensures that spare parts, supplies, and operating essentials are requisitioned and maintained. Supervises and performs maintenance management and administrative duties related to facility operations, maintenance, security, and personnel.

(3) *MOSC 74B4O.* Plans, supervises, coordinates, and provides technical assistance for the installation, operation, systems analyst functions, unit level maintenance, and management of multi-functional/ multi-user information processing systems in mobile and fixed facilities. Participates in development of the continuity of operations plan (COOP), information systems plans (ISP), information management plan (IMP), and information management master plan (IMMP). Conducts quality assurance of ADPE operations. Controls production operations in support of command or agency priorities. Develops and enforces policy and procedures for facility management. Develops, directs, and supervises training programs to ensure soldier proficiency and career development. Organizes work schedules and ensures compliance with directives and policies on operations security (OPSEC), signal security (SIGSEC), communications security (COMSEC), and physical security. Writes unit or facility standing operating procedures (SOP). Arranges higher level or contractor support maintenance for assigned equipment. Prepares or supervises the preparation of technical studies, evaluations, reports, correspondence, and records pertaining to information system operations. Directs high level programming projects. Briefs staff and operations personnel on matters pertaining to information systems.

b. Physical demands rating and qualifications for initial award of MOS. Information Systems Operator-Analysts must possess the following qualifications:

(1) A physical demands rating of very heavy.
(2) A physical profile of 212221.
(3) Normal color vision.
(4) Minimum score of 100 in aptitude area ST.
(5) A security clearance of SECRET.
(6) A U.S citizen.
(7) Be qualified for the Personnel Security and Surety Program (PSSP) per AR 380-19.
(8) Must have passed a course in High School algebra, or attained a score or 45 or higher on GED test 5, High School level.
(9) Formal training (completion of MOS 74B Course conducted under the auspices of the USA Signal School) mandatory or waiver may be granted by Commandant, U.S. Army Signal School, ATTN: ATZH-POE, Ft Gordon, GA 30905-5300, or meet the civilian acquired skills criteria listed in AR 601-210.

c. Additional skill identifiers.

(1) H4—Specialized Software Development Programmer (personnel only).
(2) P5—Master Fitness Trainer.
(3) 2S—Battle Staff Operations.
(4) 4A—Reclassification Training.

d. Related civilian occupations.

(1) *DOT classification* .
(a) Computer programmer—030.162-010.
(b) Programmer-analyst—030.162-014.
(c) Systems programmer—030.162-022.
(d) Computer operator—213.362-010.
(e) Computer peripheral equipment operator—213.382-010.
(2) *Federal civil service classification* .
(a) Computer operation—GS 0332.

(b) Computer specialist—GS 0334.

(c) Computer clerk & assistant—GS 0335.

(d) Data transcriber—GS 0356.

(e) Electric accounting machine operation—GS 0359.

(f) Electric accounting machine project planning—GS 0362.

e. *Physical requirements and standards of grade.* Physical requirements and SG relating to each skill level are listed in the following tables:

(1) *Table 2–74B–1.* Physical requirements.

(2) *Table 2–74B–2.* Standards of grade TOE/MTOE.

(3) *Table 2–74B–3.* Standards of grade TDA.

Table 2–74B–1
Physical requirements

Skill level	Task numbers	Tasks
1	1, 2, 3, 4, 5	1. Frequently lifts 60 pounds. 2. Occasionally lifts a maximum of 80 pounds. 3. Must possess finger dexterity in both hands. 4. Frequently reads complex schematic diagrams. 5. Frequently writes to keep records, compile data, and perform operational duties.
2	1, 2, 3, 4, 5	
3	3, 4, 5	
4	3,4,5	

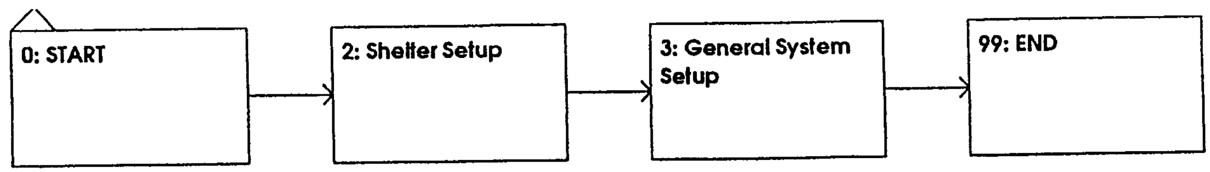
Table 2–74B–2
Standards of grade TOE/MTOE

Line	Duty position	Code	Grade	Number of positions* 1	2	3	4	5	6	7	8	9	10	Explanatory notes
1	Info sys opr-mnt	74B10	PFC			1	1	1	2	2	3	3	3	This pattern will be applied cumulatively to all positions in a paragraph.
2	Info sys opr-mnt	74B10	SPC	1	1	1	1	2	2	2	2	3	3	
3	Sr info sys opr-mnt	74B20	SGT		1	1	1	1	1	2	2	2	3	
4	Info sys team chief	74B30	SSG				1	1	1	1	1	1	1	
5	Info sys opr-mnt	74B10	PFC			1	1	1	1	2				For CTASC-II operation only. (All teams consist of a seven soldier team.)
6	Info sys opr-mnt	74B10	SPC	1	1	1	1	2	2	2				
7	Sr info sys opr-mnt	74B20	SGT		1	1	1	1	2	2				
8	Info sys team chief	74B30	SSG				1	1	1	1				
9	ADP security spc	74B10	PFC			1								ADP security team or individual ADP security soldiers.
10	ADP security spc	74B10	SPC		1	1								
11	ADP scty team chief	74B30	SSG	1	1	1								
12	JOPS analyst	74B10	PFC			1								For use with SOI N only.
13	JOPS analyst	74B10	SPC		1	1								
14	JOPS team chief	74B30	SSG	1	1	1								
15	Software analyst	74B10	PFC		1	1	1	1	2	3	3	3	3	Grades of additional positions will be in same pattern.
16	Software analyst	74B10	SPC	1	1	1	1	2	2	2	3	3	3	
17	Sr software analyst	74B20	SGT			1	1	1	1	1	1	2	2	
18	Analysis team chief	74B30	SSG				1	1	1	1	1	1	2	
19	Sr software analyst	74B20	SGT		1	1	2							For World Wide Military Command and Control System programming and analysis positions.
20	Analysis team chief	74B30	SSG	1	1	2	2							
21	Section chief	74B40	SFC											1. To supervise 10 or more software analyst. 2. As NCOIC of a DOIM when not authorized a Master Sergeant. 3. Principal information systems NCO in a WWMCCS operations branch.
22	Info sys supervisor	74B40	SFC											For supervision of 10 or more soldiers engaged in computer system operations.

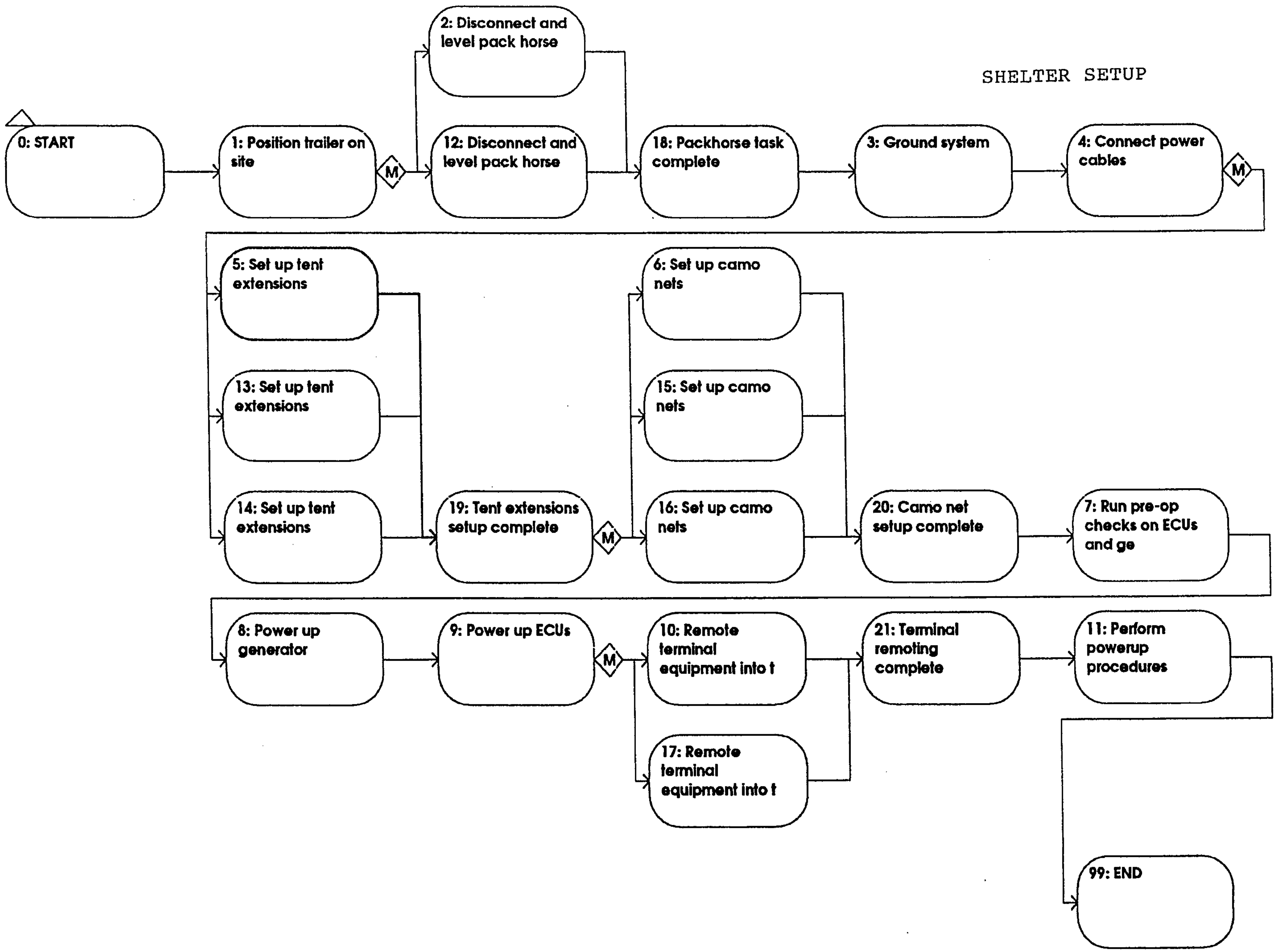
APPENDIX B

FUNCTION AND TASK FLOW DIAGRAMS FOR THE FOUR JBS V1 MISSIONS

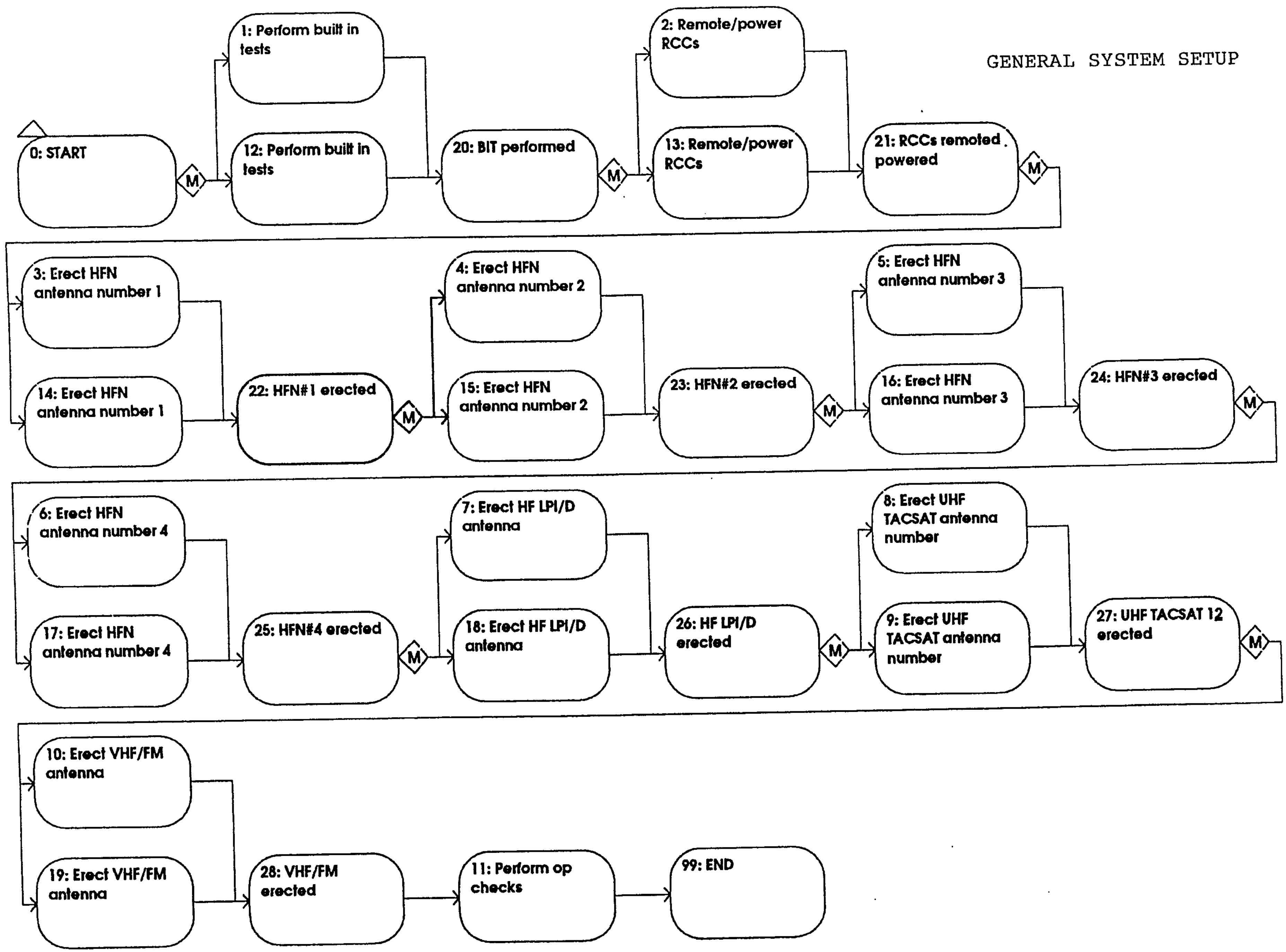
SYSTEM SETUP

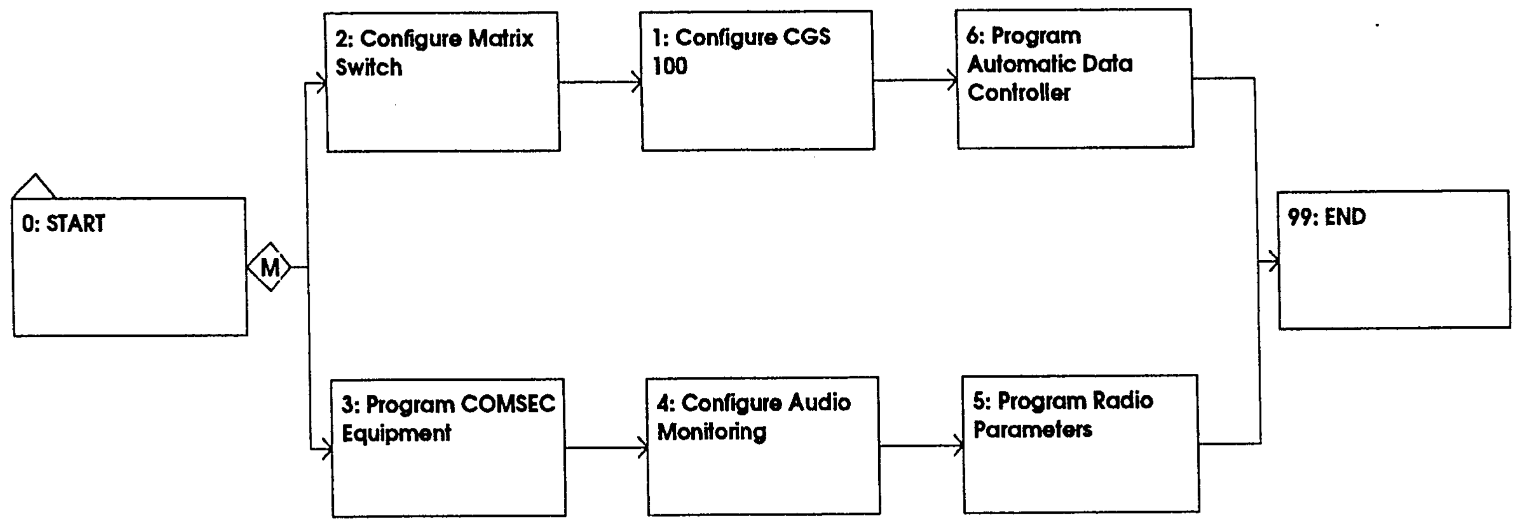


SHELTER SETUP

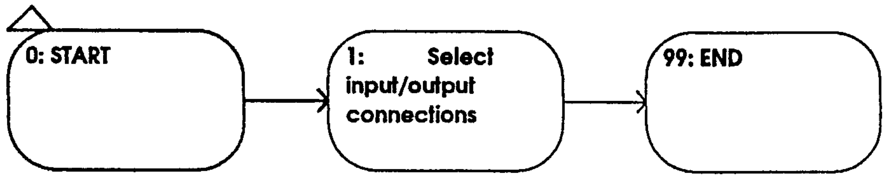


GENERAL SYSTEM SETUP

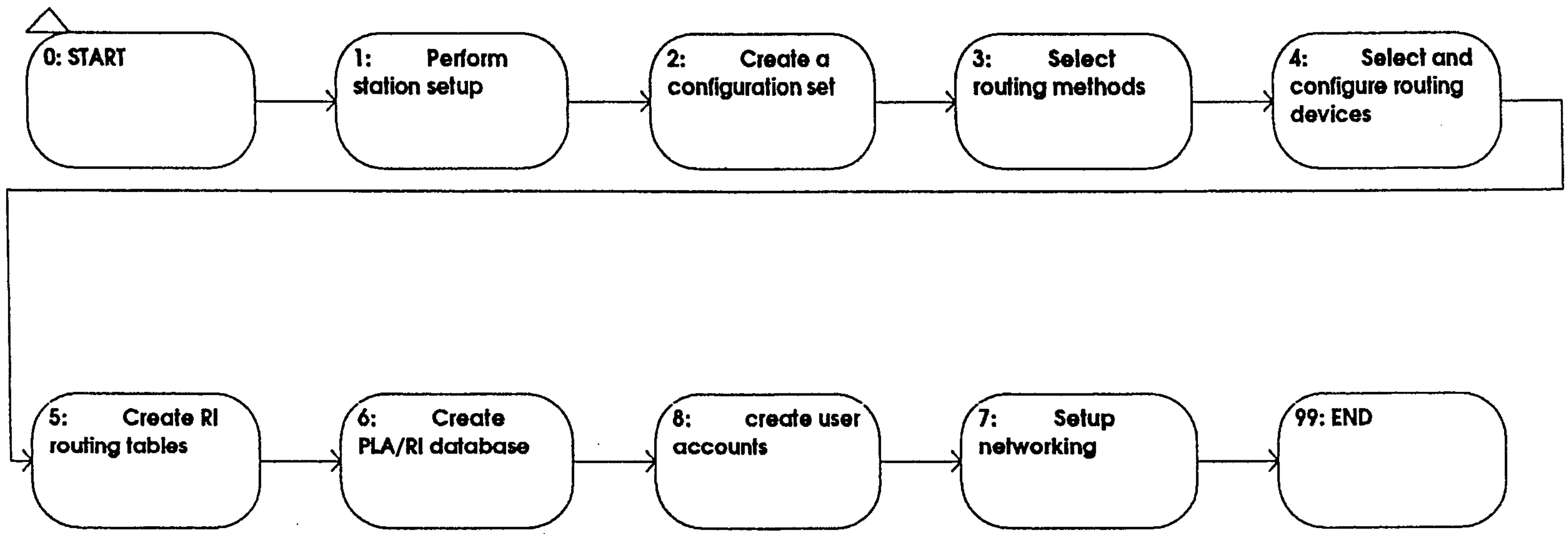



0: START
M
2: Configure Matrix Switch
1: Configure CGS 100
6: Program Automatic Data Controller
3: Program COMSEC Equipment
4: Configure Audio Monitoring
5: Program Radio Parameters
99: END

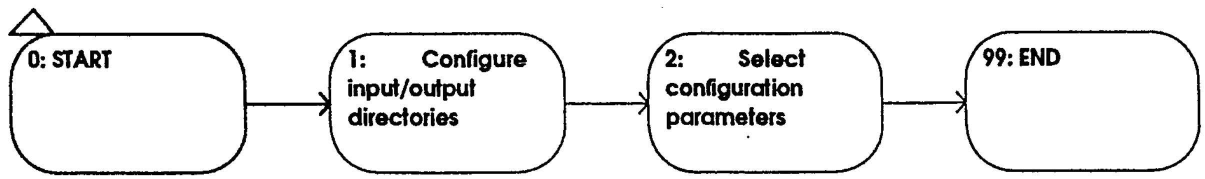
CONFIGURE MATRIX SWITCH



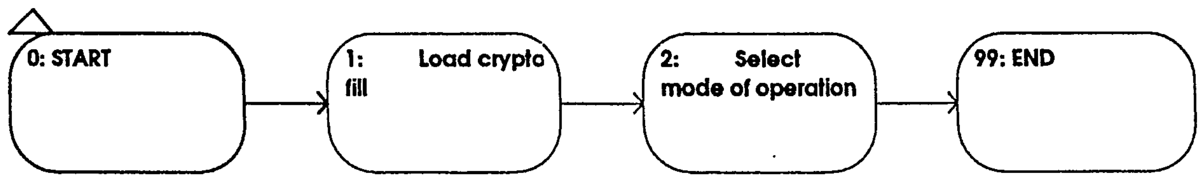
CONFIGURE CGS 100



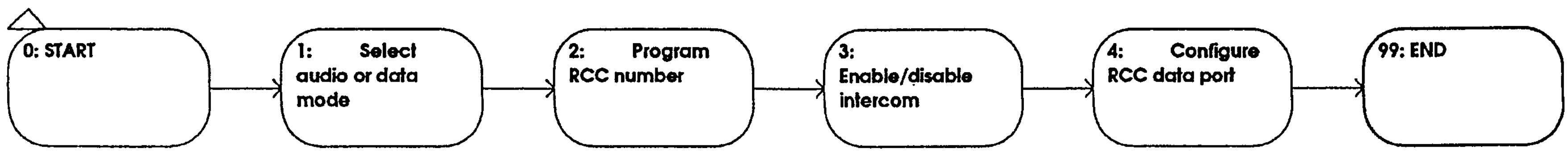
PROGRAM AUTOMATIC
DATA CONTROLLER



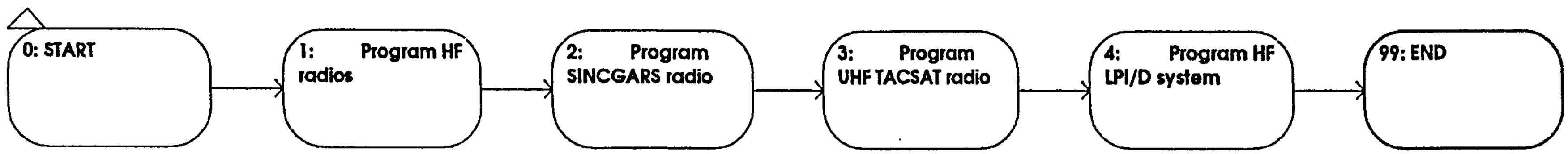
PROGRAM COMSEC EQUIPMENT



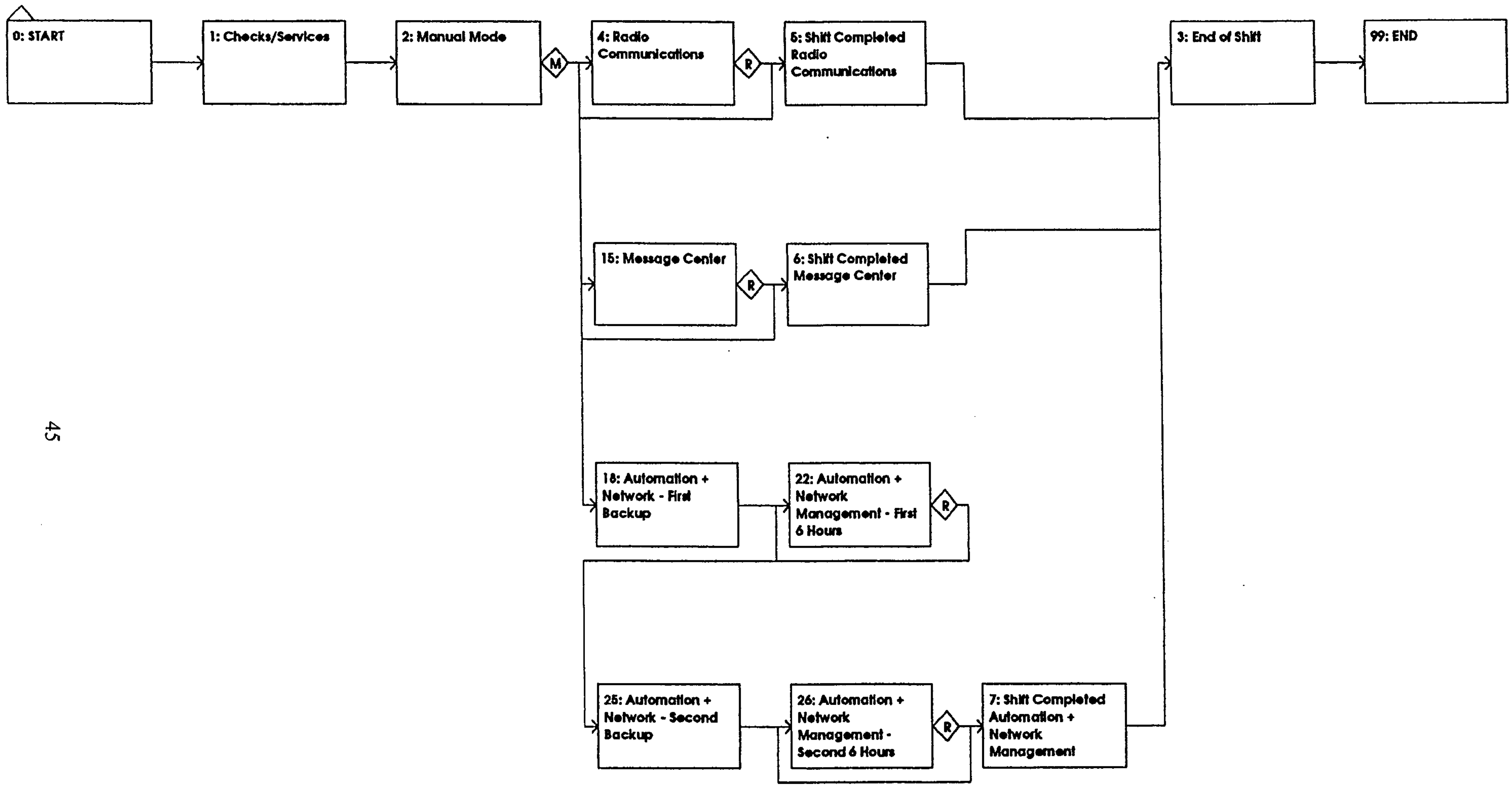
CONFIGURE AUDIO MONITORING



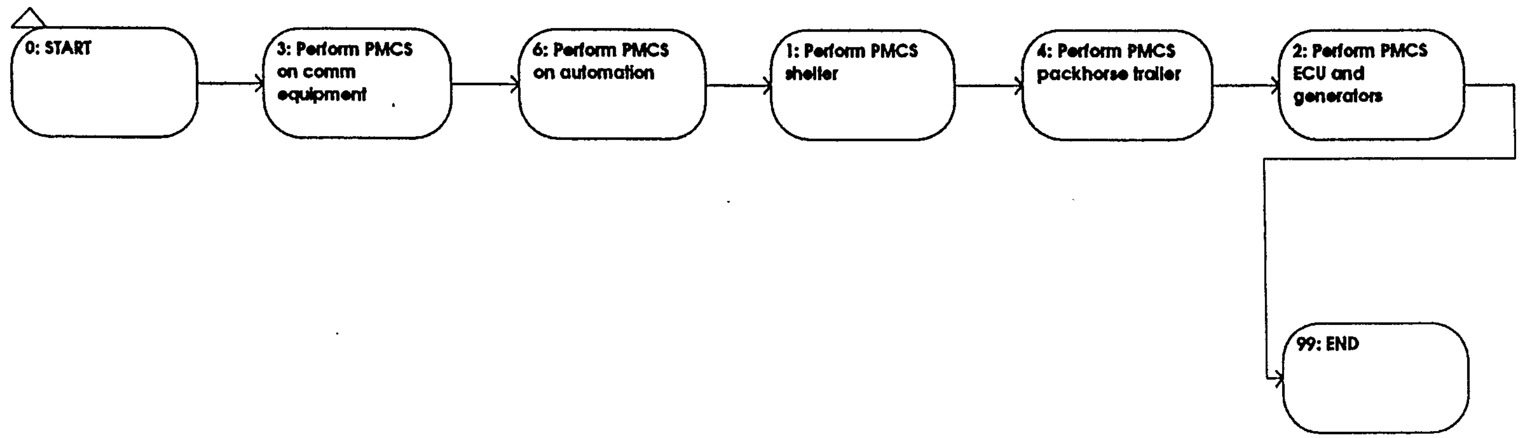
PROGRAM RADIO PARAMETERS



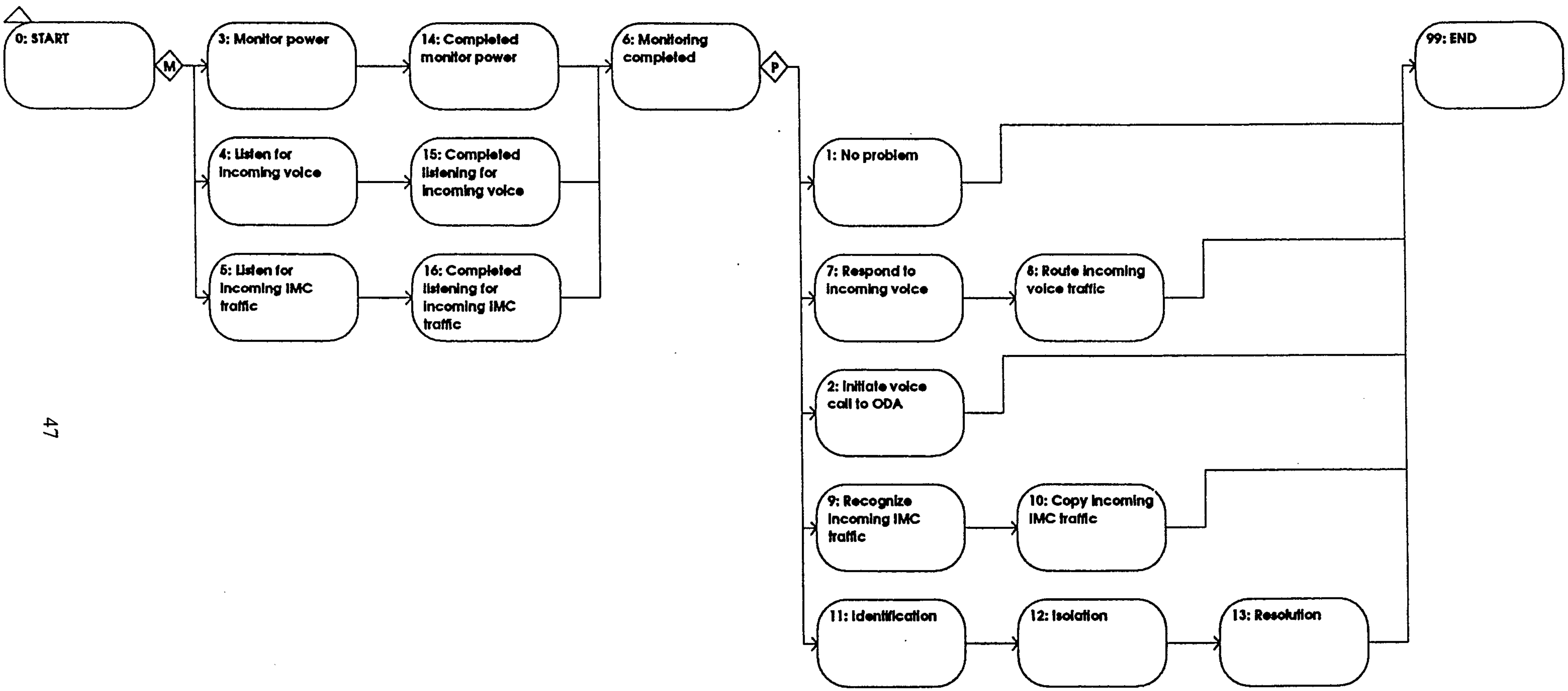
OPERATIONS


0: START
1: Checks/Services
2: Manual Mode
M
4: Radio Communications
R
5: Shift Completed Radio Communications
3: End of Shift
99: END
15: Message Center
R
6: Shift Completed Message Center
18: Automation + Network - First Backup
22: Automation + Network Management - First 6 Hours
R
25: Automation + Network - Second Backup
26: Automation + Network Management - Second 6 Hours
R
7: Shift Completed Automation + Network Management

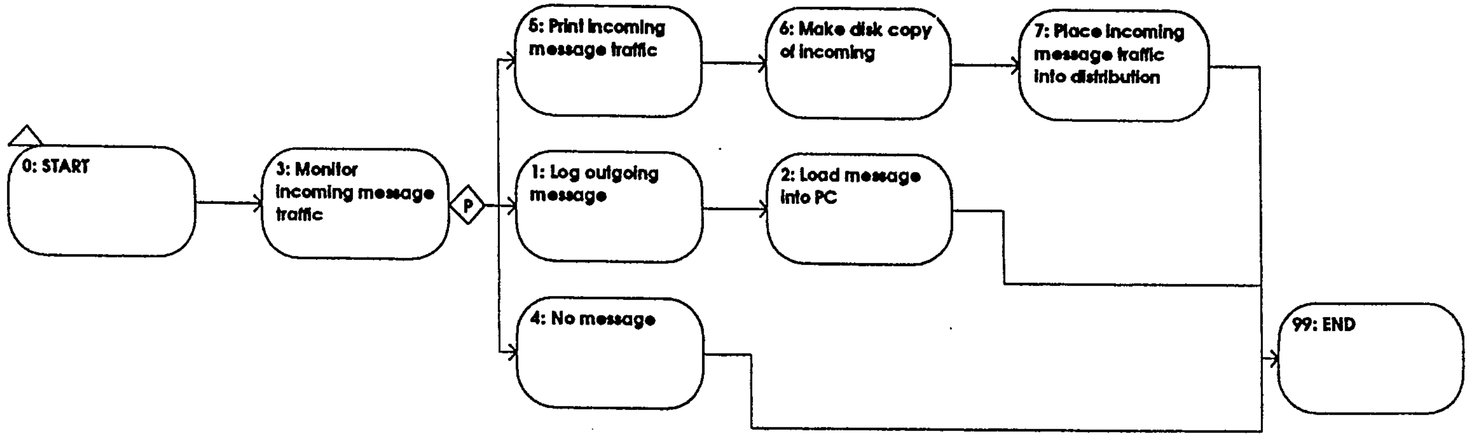
CHECKS/SERVICES



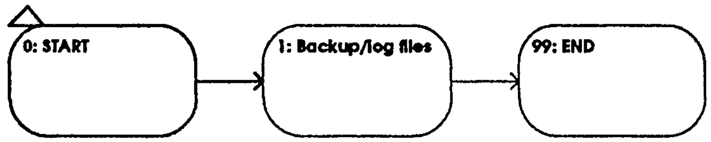
RADIO COMMUNICATIONS



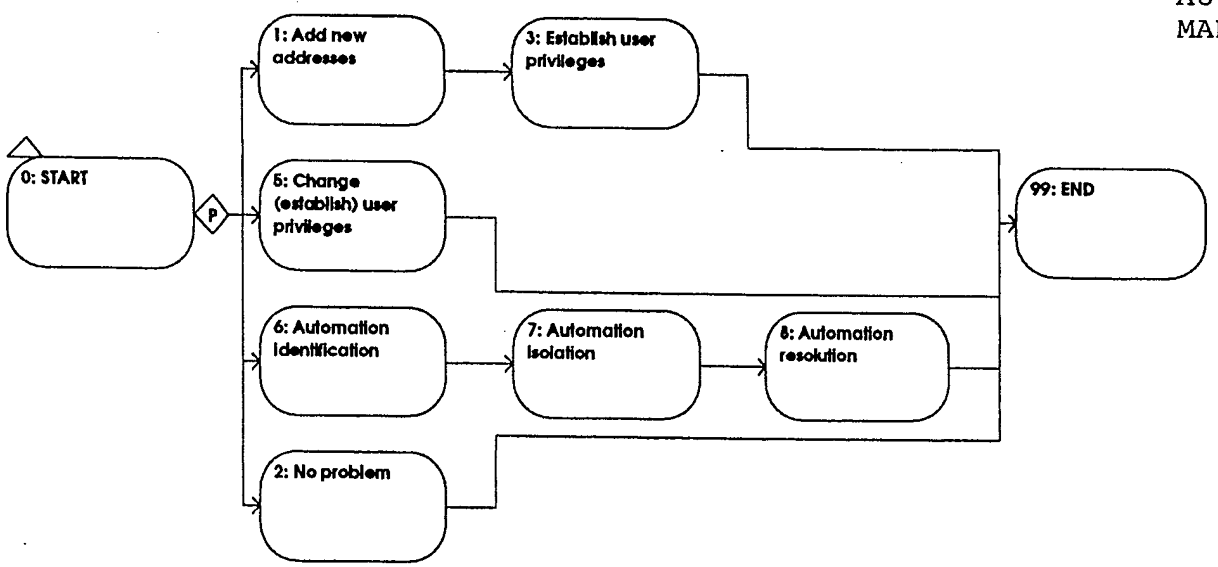
MESSAGE CENTER



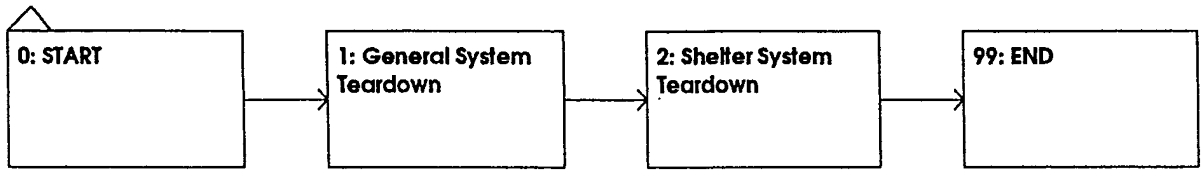
AUTOMATION & NETWORK
BACKUP



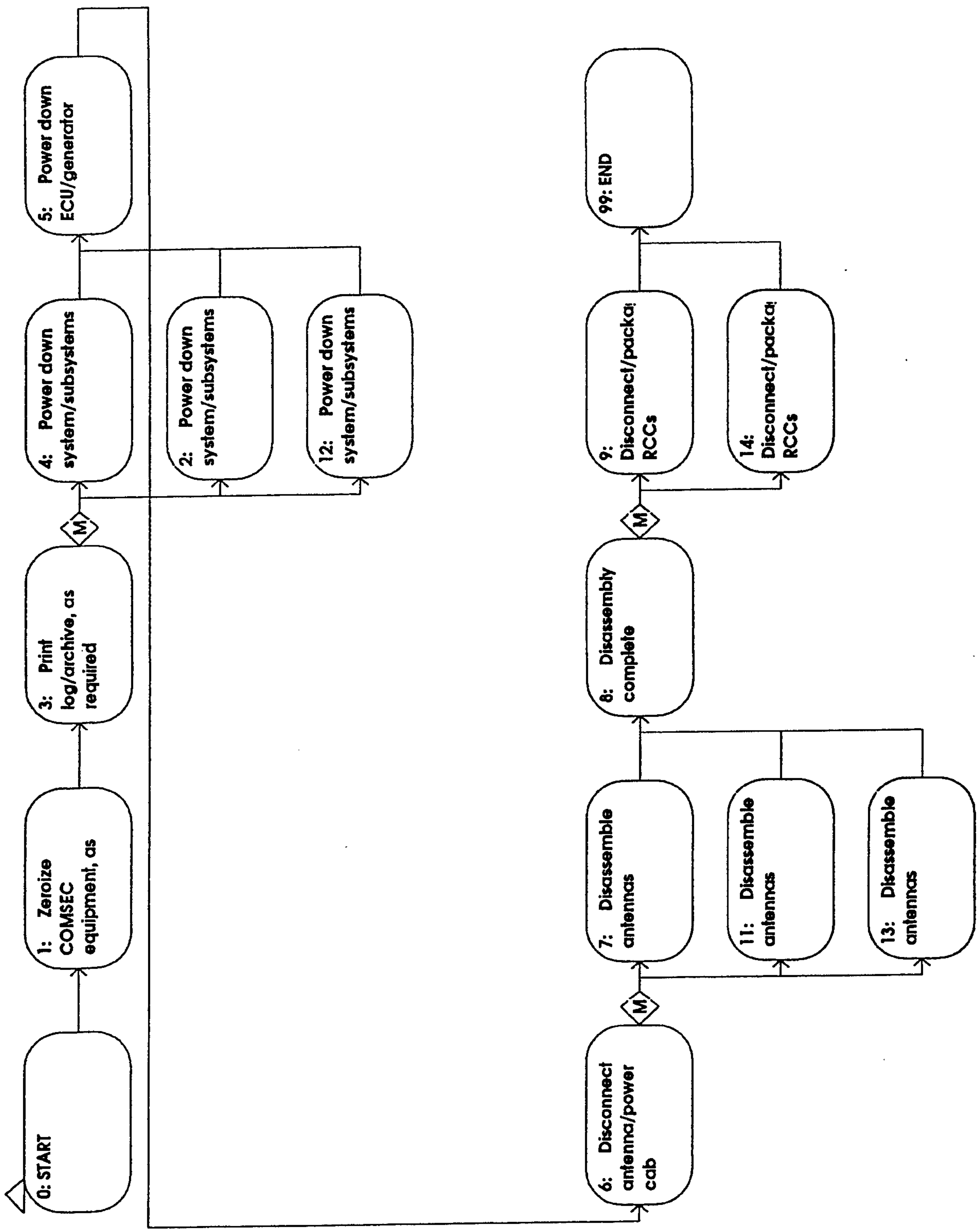
AUTOMATION & NETWORK MANAGEMENT



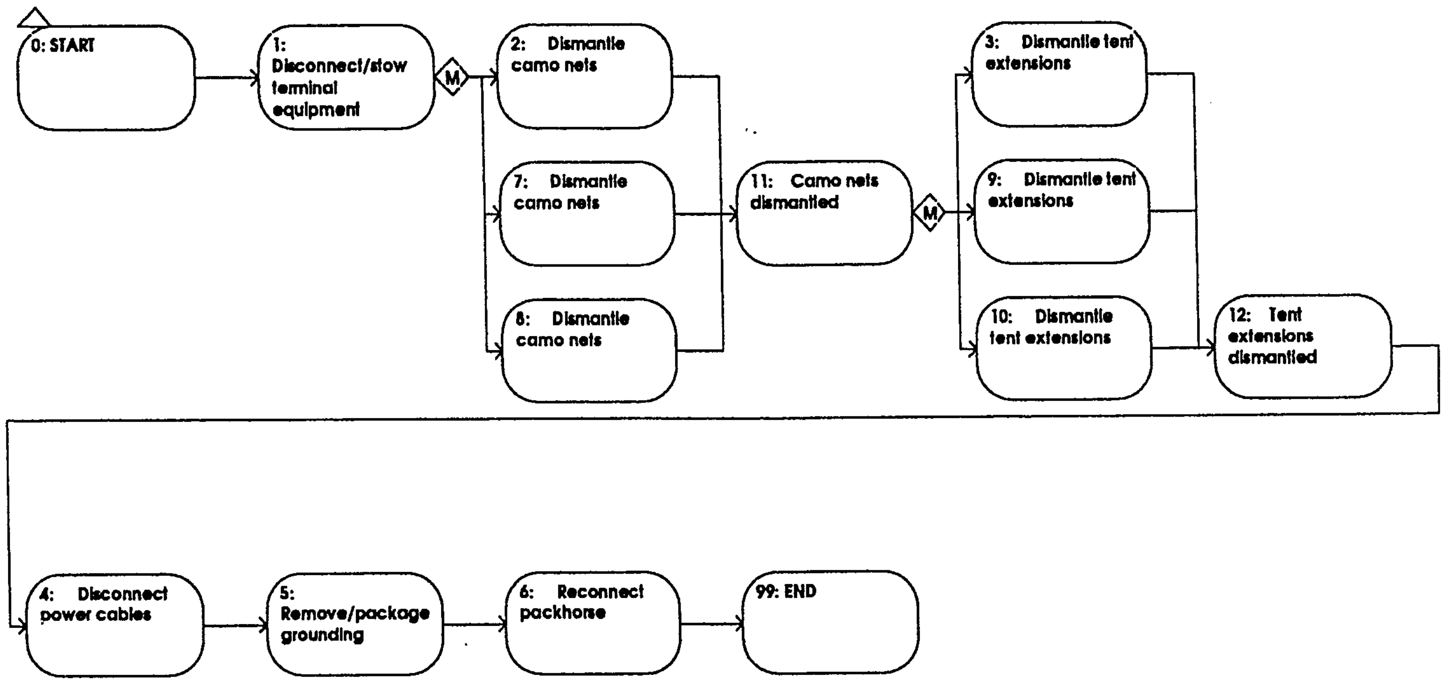
SYSTEM TEARDOWN



GENERAL SYSTEM TEARDOWN



SHELTER SYSTEM TEARDOWN



APPENDIX C

TASK TIME, ACCURACY, WORKLOAD, AND MOS DATA FOR THE FOUR JBS V1 MISSIONS

(all times are expressed in an hour:minute:second format)

Table C-1

Task Time, Accuracy, Workload, and MOS Data JBS V1 Setup

Function	Task	Time		Accuracy			Workload				
		Mean	Standard Deviation	Standard	Mean	Standard Deviation	Visual	Auditory	Cognitive	Psycho-motor	MOS(s)
Shelter Setup	Position trailer on site	0:01:00	0:00:00	80.00	90.00	3.00	5.00	4.30	4.60	2.60	18E
	Disconnect and level pack horse	0:15:00	0:00:00	80.00	90.00	3.00	5.00	0.00	1.00	4.60	74C & 74B/F
	Ground system	0:10:00	0:01:40	99.00	99.00	2.00	5.00	0.00	1.00	4.60	18E
	Connect power cables	0:10:00	0:01:40	100.00	100.00	0.00	5.00	0.00	3.70	5.80	18E
	Set up tent extensions	0:20:00	0:00:00	80.00	90.00	3.00	5.00	0.00	1.00	4.60	18E, 74C, & 74B/F
	Set up camo nets	0:15:00	0:01:40	80.00	90.00	3.00	5.00	0.00	1.00	4.60	18E, 74C, & 74B/F
	Run pre-op checks on ECUs and generator	0:05:00	0:01:00	80.00	90.00	3.00	5.90	0.00	4.60	5.80	18E
	Power up generator	0:02:00	0:00:20	100.00	100.00	0.00	5.90	1.00	3.70	2.20	18E
	Power up ECUs	0:01:00	0:00:00	100.00	100.00	0.00	3.70	0.00	1.00	2.20	18E
	Remote terminal equipment into tent	0:05:00	0:00:00	90.00	95.00	1.00	5.00	0.00	3.70	4.60	74C & 74B/F
	Perform powerup procedures	0:03:00	0:00:20	99.00	99.00	1.00	5.90	0.00	3.70	2.20	18E
General System Setup	Perform built in tests	0:05:00	0:00:00	90.00	95.00	1.00	5.90	0.00	3.70	7.00	18E & 74C
	Remote/power RCCs	0:20:00	0:00:00	90.00	95.00	1.00	5.00	0.00	6.80	4.60	18E & 74C
	Erect HFN antenna #1	0:15:00	0:03:00	80.00	90.00	2.00	5.00	0.00	4.60	5.80	18E & 74C
	Erect HFN antenna #2	0:15:00	0:03:20	80.00	90.00	2.00	5.00	0.00	4.60	5.80	18E & 74C
	Erect HFN antenna #3	0:15:00	0:03:20	80.00	90.00	2.00	5.00	0.00	4.60	5.80	18E & 74C
	Erect HFN antenna #4	0:15:00	0:03:20	80.00	90.00	2.00	5.00	0.00	4.60	5.80	18E & 74C
	Erect HF LPI/D antenna	0:15:00	0:03:20	80.00	90.00	2.00	5.00	0.00	4.60	5.80	18E & 74C
	Erect UHF TACSAT antenna #1	0:10:00	0:01:40	80.00	90.00	2.00	5.00	0.00	4.60	5.80	18E
	Erect UHF TACSAT antenna #2	0:10:00	0:01:40	80.00	90.00	2.00	5.00	0.00	4.60	5.80	74C
	Erect VHF/FM antenna	0:15:00	0:03:20	80.00	90.00	2.00	5.00	0.00	4.60	5.80	18E & 74C
	Perform op checks	0:05:00	0:01:00	80.00	90.00	2.00	5.90	0.00	4.60	7.00	18E & 74C

Table C-2

Task Time, Accuracy, Workload, and MOS Data JBS V1 Programming

		Time		Accuracy			Workload				
Function	Task	Mean	Standard Deviation	Standard	Mean	Standard Deviation	Visual	Auditory	Cognitive	Psycho-motor	MOS(s)
Configure CGS 100	Perform station setup	0:02:00	0:00:20	90.00	92.00	1.00	5.90	0.00	4.60	7.00	74B/F
	Create a configuration set	0:01:00	0:00:10	97.00	99.00	1.00	5.90	0.00	3.70	7.00	74B/F
	Select routing methods	0:02:00	0:00:20	97.00	99.00	1.00	5.90	0.00	6.80	7.00	74B/F
	Select and configure routing devices	0:30:00	0:06:45	97.00	99.00	1.00	5.90	0.00	6.80	7.00	74B/F
	Create RI routing tables	0:30:00	0:06:45	97.00	99.00	1.00	5.90	0.00	3.70	7.00	74B/F
	Create PLA/RI database	1:00:00	0:10:00	97.00	99.00	1.00	5.90	0.00	3.70	7.00	74B/F
	Setup networking	0:45:00	0:08:33	97.00	99.00	1.00	5.90	0.00	6.80	7.00	74B/F
	Create user accounts	0:20:00	0:05:00	90.00	92.00	1.00	5.90	0.00	3.70	7.00	74B/F
Configure Matrix Switch	Select input/output connections	0:02:00	0:00:33	97.00	99.00	1.00	5.00	0.00	6.80	4.60	74B/F
Program COMSEC Equipment	Load crypto fill	0:15:00	0:01:33	97.00	99.00	1.00	5.90	7.00	6.80	5.80	18E
	Select mode of operation	0:25:00	0:03:33	97.00	99.00	1.00	5.90	7.00	6.80	5.80	18E
Configure Audio Monitoring	Select audio or data mode	0:10:00	0:01:33	97.00	99.00	0.00	5.90	0.00	1.00	2.20	18E
	Program RCC number	0:10:00	0:01:33	97.00	99.00	1.00	5.90	0.00	6.80	5.80	18E
	Enable/disable intercom	0:02:00	0:00:20	97.00	99.00	0.00	5.90	0.00	1.20	5.80	18E
	Configure RCC data port	0:10:00	0:01:33	97.00	99.00	1.00	5.90	0.00	6.80	5.80	18E
Program Radio Parameters	Program HF radios	0:30:00	0:05:00	97.00	99.00	1.00	5.90	0.00	6.80	7.00	18E
	Program SINCGARS radio	0:03:00	0:00:40	97.00	99.00	1.00	5.90	0.00	6.80	7.00	18E
	Program UHF TACSAT radio	0:10:00	0:01:15	97.00	99.00	1.00	5.90	0.00	6.80	7.00	18E
	Program HF LPI/D system	0:30:00	0:01:40	97.00	99.00	1.00	5.90	0.00	6.80	7.00	18E
Program Automatic Data Controller	Configure input/output directories	0:10:00	0:01:45	97.00	99.00	1.00	5.90	0.00	6.80	7.00	74B/F
	Select configuration parameters	0:10:00	0:01:45	97.00	99.00	1.00	5.90	0.00	6.80	7.00	74B/F

Table C-3

Task Time, Accuracy, Workload, and MOS Data JBS V1 Operations

Function	Task	Time		Accuracy			Workload				
		Mean	Standard Deviation	Standard	Mean	Standard Deviation	Visual	Auditory	Cognitive	Psycho-motor	MOS(s)
Checks/Services	Perform PMCS shelter	0:05:00	0:00:40	90.00	95.00	3.00	5.90	0.00	4.60	4.60	18E
	Perform PMCS ECU and generators	0:05:00	0:00:40	90.00	95.00	3.00	5.90	1.00	4.60	4.60	18E
	Perform PMCS on comm equipment	0:10:00	0:01:40	90.00	95.00	3.00	5.90	1.00	4.60	4.60	18E
	Perform PMCS packhorse trailer	0:05:00	0:00:40	90.00	95.00	3.00	5.90	1.00	4.60	4.60	18E
	Perform PMCS on automa-tion	0:05:00	0:00:40	90.00	95.00	3.00	5.90	0.00	4.60	5.80	74B/F
Radio Communications	Monitor power	0:02:00	0:00:30	90.00	95.00	4.00	0.00	0.00	0.00	0.00	18E
	Listen for incoming voice	0:02:00	0:01:00	97.00	99.00	1.25	0.00	4.90	5.30	5.80	18E
	Listen for incoming IMC traffic	0:02:00	0:01:00	97.00	99.00	1.25	0.00	7.00	4.60	0.00	18E
	Respond to incoming voice	0:01:00	0:00:10	97.00	99.00	0.50	3.70	4.90	5.30	5.80	18E
	Route incoming voice traffic	0:01:00	0:00:10	97.00	99.00	1.00	5.90	0.00	4.60	5.80	18E
	Initiate voice call to ODA	0:01:00	0:00:10	97.00	99.00	1.00	5.00	1.00	6.80	2.20	18E
	Recognize incoming IMC traffic	0:01:00	0:00:10	85.00	90.00	6.00	0.00	7.00	3.70	0.00	18E
	Copy incoming IMC traffic	0:10:00	0:01:40	97.00	99.00	1.00	5.00	0.00	1.00	5.80	18E
	Identification	0:01:00	0:00:10	97.00	99.00	1.00	0.00	1.00	6.80	7.00	18E
	Isolation	0:05:00	0:03:00	97.00	99.00	1.25	7.00	6.60	6.80	7.00	18E
	Resolution	0:10:00	0:05:00	97.00	99.00	1.00	5.90	1.00	4.60	7.00	18E
Message Center	Monitor incoming message traffic	0:01:00	0:01:00	97.00	99.00	1.00	0.00	1.00	3.70	0.00	74C
	Print incoming message traffic	0:01:00	0:00:10	90.00	99.00	1.00	5.90	0.00	6.80	2.20	74C
	Make disk copy of incoming	0:01:00	0:00:10	90.00	99.00	1.00	5.90	0.00	4.60	5.80	74C
	Place incoming message traffic in distribution	0:01:00	0:00:10	97.00	99.00	1.00	3.70	4.30	1.20	5.80	74C
	Log outgoing message	0:01:00	0:00:10	80.00	90.00	6.00	5.90	0.00	6.80	6.50	74C
	Load message in PC	0:03:00	0:00:40	97.00	99.00	1.00	5.90	0.00	6.80	7.00	74C
Automation + Network - 1st & 2nd Backup	Backup/log files	0:01:00	0:00:10	90.00	95.00	4.00	5.90	0.00	4.60	7.00	74B/F
Automation + Network Manage-ment - 1st & 2nd Shift	Add new addresses	0:03:00	0:00:40	95.00	97.00	1.00	5.90	0.00	6.80	7.00	74B/F
	Establish user privileges	0:03:00	0:00:40	95.00	97.00	1.00	5.90	0.00	6.80	7.00	74B/F
	Change (establish) user privileges	0:03:00	0:00:40	95.00	97.00	1.00	5.90	0.00	6.80	7.00	74B/F
	Automation identification	0:01:00	0:00:10	95.00	97.00	1.00	5.90	1.00	3.70	0.00	74B/F
	Automation isolation	0:05:00	0:01:10	95.00	97.00	1.50	7.00	1.00	6.80	7.00	74B/F
	Automation resolution	0:20:00	0:03:33	95.00	97.00	1.00	5.90	1.00	6.80	5.80	74B/F

Table C-4

Task Time, Accuracy, Workload, and MOS Data JBS V1 Tear Down

		Time		Accuracy			Workload				
Function	Task	Mean	Standard Deviation	Standard*	Mean*	Standard Deviation*	Visual	Auditory	Cognitive	Psycho-motor	MOS(s)
General System Teardown	Zeroize COMSEC equipment, as required	0:03:00	0:00:40	100.00	100.00	0.00	5.90	1.00	4.60	5.80	18E
	Print log/archive, as required	0:01:00	0:00:10	100.00	100.00	0.00	5.90	1.00	4.60	5.80	18E
	Power down system/ subsystems	0:03:00	0:00:40	100.00	100.00	0.00	3.70	1.00	4.60	5.80	18E, 74C, & 74B/F
	Power down ECU/generator	0:03:00	0:00:40	100.00	100.00	0.00	3.70	1.00	4.60	5.80	18E
	Disconnect antenna/power cables	0:03:00	0:00:40	100.00	100.00	0.00	3.70	0.00	4.60	4.60	18E
	Disassemble antennas & stow	1:00:00	0:05:00	100.00	100.00	0.00	3.70	0.00	4.60	5.80	18E, 74C, 74B/F
	Disconnect/package RCCs	0:20:00	0:01:40	100.00	100.00	0.00	5.00	0.00	4.60	5.80	18E, 74C
Shelter System Teardown	Disconnect/stow terminal equipment	0:05:00	0:00:40	100.00	100.00	0.00	5.00	0.00	4.60	5.80	18E
	Dismantle camo nets	0:15:00	0:01:40	100.00	100.00	0.00	5.00	0.00	4.60	5.80	18E, 74C, 74B/F
	Dismantle tent extensions	0:15:00	0:01:40	100.00	100.00	0.00	5.00	0.00	4.60	5.80	18E, 74C, 74B/F
	Disconnect power cables	0:10:00	0:01:40	100.00	100.00	0.00	5.00	0.00	4.60	5.80	18E
	Remove/package grounding	0:10:00	0:01:40	100.00	100.00	0.00	5.00	0.00	4.60	5.80	18E
	Reconnect packhorse	0:10:00	0:01:40	100.00	100.00	0.00	5.00	0.00	4.60	5.80	18E

* Accuracy was not a variable in the Teardown mission.

NO. OF COPIES	ORGANIZATION
2	ADMINISTRATOR DEFENSE TECHNICAL INFO CENTER ATTN DTIC DDA 8725 JOHN J KINGMAN RD STE 0944 FT BELVOIR VA 22060-6218
1	DIRECTOR US ARMY RESEARCH LABORATORY ATTN AMSRL CS AL TA RECORDS MANAGEMENT 2800 POWDER MILL RD ADELPHI MD 20783-1197
1	DIRECTOR US ARMY RESEARCH LABORATORY ATTN AMSRL CI LL TECHNICAL LIBRARY 2800 POWDER MILL RD ADELPHI MD 207830-1197
1	DIRECTOR US ARMY RESEARCH LABORATORY ATTN AMSRL CS AL TP TECH PUBLISHING BRANCH 2800 POWDER MILL RD ADELPHI MD 20783-1197
1	DIRECTORATE FOR MANPRINT ATTN DAPE MR DEPUTY CHIEF OF STAFF PERSONNEL 300 ARMY PENTAGON WASHINGTON DC 20310-0300
1	OUSD(A)/DDDR&E(R&A)/E&LS PENTAGON ROOM 3D129 WASHINGTON DC 20301-3080
1	CODE 1142PS OFFICE OF NAVAL RESEARCH 800 N QUINCY STREET ARLINGTON VA 22217-5000
1	WALTER REED ARMY INST OF RSCH ATTN SGRD UWI C (COL REDMOND) WASHINGTON DC 20307-5100
1	DR ARTHUR RUBIN NATL INST OF STANDARDS & TECH BUILDING 226 ROOM A313 GAITHERSBURG MD 20899

NO. OF COPIES	ORGANIZATION
1	COMMANDER US ARMY RESEARCH INSTITUTE ATTN PERI ZT (DR E M JOHNSON) 5001 EISENHOWER AVENUE ALEXANDRIA VA 22333-5600
1	DEFENSE LOGISTICS STUDIES INFORMATION EXCHANGE ATTN DIRECTOR DLSIE ATSZ DL BLDG 12500 2401 QUARTERS ROAD FORT LEE VA 23801-1705
1	DEPUTY COMMANDING GENERAL ATTN EXS (Q) MARINE CORPS RD&A COMMAND QUANTICO VA 22134
1	HEADQUARTERS USATRADOC ATTN ATCD SP FORT MONROE VA 23651
1	COMMANDER USATRADOC COMMAND SAFETY OFFICE ATTN ATOS (MR PESSAGNO/MR LYNE) FORT MONROE VA 23651-5000
1	COMMANDER US ARMY MATERIEL COMMAND ATTN AMCAM 5001 EISENHOWER AVENUE ALEXANDRIA VA 22333-0001
1	DIRECTOR TDAD DCST ATTN ATTG C BLDG 161 FORT MONROE VA 23651-5000
1	COMMANDER USA OPERATIONAL TEST & EVAL AGENCY ATTN CSTE TSM 4501 FORD AVE ALEXANDRIA VA 22302-1458
1	HQ USAMRDC ATTN SGRD PLC FORT DETRICK MD 21701
1	COMMANDER USA AEROMEDICAL RESEARCH LAB ATTN LIBRARY FORT RUCKER AL 36362-5292

NO. OF COPIES	ORGANIZATION
1	AIR FORCE FLIGHT DYNAMICS LAB ATTN AFWAL/FIES/SURVIAC WRIGHT PATTERSON AFB OH 45433
1	AAMRL/HE WRIGHT PATTERSON AFB OH 45433-6573
1	US ARMY NATICK RD&E CENTER ATTN STRNC YBA NATICK MA 01760-5020
1	US ARMY TROOP SUPPORT CMD NATICK RD&E CENTER ATTN BEHAVIORAL SCI DIV SSD NATICK MA 01760-5020
1	US ARMY TROOP SUPPORT CMD NATICK RD&E CENTER ATTN TECH LIBRARY (STRNC MIL) NATICK MA 01760-5040
1	LOCKHEED SANDERS INC BOX MER 24 1583 NASHUA NH 03061-0868
1	USAF ARMSTRONG LAB/CFTO ATTN DR F WESLEY BAUMGARDNER SUSTAINED OPERATIONS BRANCH BROOKS AFB TX 78235-5000
1	AFHRL/PRTS BROOKS AFB TX 78235-5601
1	DR JON FALLESEN ARI FIELD UNIT PO BOX 3407 FORT LEAVENWORTH KS 66027-0347
1	COMMANDER USAMC LOGISTICS SUPPORT ACTIVITY ATTN AMXLS AE REDSTONE ARSENAL AL 35898-7466
1	ARI FIELD UNIT FORT KNOX BUILDING 2423 PERI IK FORT KNOX KY 40121-5620
1	COMMANDANT USA ARTILLERY & MISSILE SCHOOL ATTN USAAMS TECH LIBRARY FORT SILL OK 73503

NO. OF COPIES	ORGANIZATION
1	COMMANDER WHITE SANDS MISSILE RANGE ATTN TECHNICAL LIBRARY WHITE SANDS MISSILE RANGE NM 88002
1	USA TRADOC ANALYSIS COMMAND ATTN ATRC WSR (D ANGUIANO) WHITE SANDS MISSILE RANGE NM 88002-5502
1	STRICOM 12350 RESEARCH PARKWAY ORLANDO FL 32826-3276
1	COMMANDER USA TANK-AUTOMOTIVE R&D CENTER ATTN AMSTA RS/D REES WARREN MI 48090
1	COMMANDER USA TANK-AUTOMOTIVE R&D CENTER ATTN AMSTA TSL (TECH LIBRARY) WARREN MI 48397-5000
1	INSTITUTE FOR DEFENSE ANALYSES ATTN DR JESSE ORLANSKY 1801 N BEAUREGARD STREET ALEXANDRIA VA 22311
1	GOVT PUBLICATIONS LIBRARY 409 WILSON M UNIVERSITY OF MINNESOTA MINNEAPOLIS MN 55455
1	DR RICHARD PEW BBN SYSTEMS AND TECH CORP 10 MOULTON STREET CAMBRIDGE MA 02138
1	DR HARVEY A TAUB RSCH SECTION PSYCH SECTION VETERANS ADMIN HOSPITAL IRVING AVENUE & UNIVERSITY PLACE SYRACUSE NY 13210
1	DR ANTHONY DEBONS IDIS UNIVERSITY OF PITTSBURGH PITTSBURGH PA 15260
1	MR R BEGGS BOEING-HELICOPTER CO P30-18 PO BOX 16858 PHILADELPHIA PA 19142

NO. OF COPIES	ORGANIZATION
1	DR ROBERT KENNEDY ESSEX CORPORATION SUITE 227 1040 WOODCOCK ROAD ORLANDO FL 32803
1	DR NANCY ANDERSON DEPARTMENT OF PSYCHOLOGY UNIVERSITY OF MARYLAND COLLEGE PARK MD 20742
1	MR LARRY W AVERY BATTELLE PACIFIC NW LABS PO BOX 999 MAIL STOP K6-66 RICHLAND WA 99352
1	DR BEN B MORGAN DEPARTMENT OF PSYCHOLOGY UNIVERSITY OF CENTRAL FLORIDA PO BOX 25000 ORLANDO FL 32816
1	AFHRL/CA BROOKS AFB TX 78235
1	LAWRENCE C PERLMUTER PHD UNIV OF HEALTH SCIENCES THE CHICAGO MEDICAL SCHOOL DEPT OF PSYCHOLOGY 3333 GREEN BAY ROAD NORTH CHICAGO IL 60064
1	DR ARTHUR S KAMLET BELL LABORATORIES 6200 EAST BROAD STREET COLUMBUS OH 43213
1	GENERAL MOTORS CORPORATION NORTH AMERICAN OPERATIONS PORTFOLIO ENGINEERING CENTER HUMAN FACTORS ENGINEERING ATTN MR A J ARNOLD STAFF PROJ ENG ENGINEERING BLDG 30200 MOUND RD BOX 9010 WARREN MI 48090-9010
1	GENERAL DYNAMICS LAND SYSTEMS DIV LIBRARY PO BOX 1901 WARREN MI 48090
1	DR LLOYD A AVANT DEPARTMENT OF PSYCHOLOGY IOWA STATE UNIVERSITY AMES IA 50010

NO. OF COPIES	ORGANIZATION
1	DR PAUL R MCCRIGHT INDUSTRIAL ENGINEERING DEPT KANSAS STATE UNIVERSITY MANHATTA KS 66502
1	DR MM AYOUB DIRECTOR INST FOR ERGONOMICS RESEARCH TEXAS TECH UNIVERSITY LUBBOCK TX 79409
1	MR KENNETH C CROMBIE TECHNICAL LIBRARIAN E104 DELCO SYSTEMS OPERATIONS 6767 HOLLISTER AVENUE GOLETA CA 93117
1	MR WALT TRUSZKOWSKI CODE 522.3 NASA/GODDARD SPACE FLIGHT CENTER GREENBELT MD 20771
1	DIRECTOR US ARMY AEROFLIGHT DYNAMICS DIR ATTN SAVRT AF D (A W KERR) AMES RESEARCH CENTER (MS 215-1) MOFFETT FIELD CA 94035-1099
1	DR NORMAN BADLER DEPT OF COMPUTER & INFORMATION SCIENCE UNIVERSITY OF PENNSYLVANIA PHILADELPHIA PA 19104-6389
1	COMMANDER US ARMY RESEARCH INSTITUTE OF ENVIRONMENTAL MEDICINE NATICK MA 01760-5007
1	DR DANIEL J POND BATTELLE PNL/K6-66 PO BOX 999 RICHLAND WA 99350
1	HQDA (DAPE ZXO) ATTN DR FISCHL WASHINGTON DC 20310-0300
1	HUMAN FACTORS ENG PROGRAM DEPT OF BIOMEDICAL ENGINEERING COLLEGE OF ENGINEERING & COMPUTER SCIENCE WRIGHT STATE UNIVERSITY DAYTON OH 45435

NO. OF COPIES	ORGANIZATION
1	PEO STANDARD ARMY MGMT INFORMATION SYSTEM ATTN AS PES STOP C-3 FT BELVOIR VA 22060-5456
1	PEO ARMORED SYS MODERNIZATION US ARMY TANK-AUTOMOTIVE CMD ATTN SFAE ASM S WARREN MI 48397-5000
1	PEO COMBAT SUPPORT ATTN AMCPEO CS US ARMY TANK AUTOMOTIVE CMD WARREN MI 48397-5000
1	PEO MGMT INFORMATION SYSTEMS ATTN AS PEM STOP C-2 BLDG 1465 FT BELVOIR VA 22060-5456
1	PEO ARMAMENTS ATTN AMCPEO AR BLDG 171 PICATINNY ARSENAL NJ 07806-5000
1	PEO INTELLIGENCE & ELECTRONIC WARFARE ATTN AMCPEO IEW VINT HILL FARMS STATION BLDG 197 WARRENTON VA 22186-5115
1	PEO COMMUNICATIONS ATTN SFAE CM RE FT MONMOUTH NJ 07703-5000
1	PEO AIR DEFENSE ATTN SFAE AD S US ARMY MISSILE COMMAND REDSTONE ARSENAL AL 35898-5750
1	PEO STRATEGIC DEFENSE PO BOX 15280 ATTN DASD ZA US ARMY STRATEGIC DEFENSE CMD ARLINGTON VA 22215-0280
1	PROGRAM MANAGER RAH-66 4300 GOODFELLOW BLVD ST LOUIS MO 63120-1798
1	DENNIS L SCHMICKLY CREW SYSTEMS ENGINEERING MCDONNELL DOUGLAS HELICOPTER 5000 EAST MCDOWELL ROAD MESA AZ 85205-9797

NO. OF COPIES	ORGANIZATION
1	JON TATRO HUMAN FACTORS SYSTEM DESIGN BELL HELICOPTER TEXTRON INC PO BOX 482 MAIL STOP 6 FT WORTH TX 76101
1	CHIEF CREW SYSTEMS INTEGRATION SIKORSKY AIRCRAFT M/S S3258 NORTH MAIN STREET STRATFORD CT 06602
1	JOHN B SHAFER 250 MAIN STREET OWEGO NY 13827
1	OASD (FM&P) WASHINGTON DC 20301-4000
1	COMMANDER US ARMY MATERIEL COMMAND ATTN AMCDE AQ 5001 EISENHOWER AVENUE ALEXANDRIA VA 22333
1	COMMANDANT US ARMY ARMOR SCHOOL ATTN ATSB CDS (MR LIPSCOMB) FT KNOX KY 40121-5215
1	COMMANDER US ARMY AVIATION CENTER ATTN ATZQ CDM S (MR MCCRACKEN) FT RUCKER AL 36362-5163
1	COMMANDER US ARMY SIGNAL CTR & FT GORDON ATTN ATZH CDM FT GORDON GA 30905-5090
1	DIRECTOR US ARMY AEROFLIGHT DYNAMICS DIR MAIL STOP 239-9 NASA AMES RESEARCH CENTER MOFFETT FIELD CA 94035-1000
1	PROJECT MANAGER SIGNALS WARFARE ATTN SFAE IEW SG (ALAN LINDLEY) BLDG P-181 VINT HILL FARMS STATION WARRENTON VA 22186-5116
1	COMMANDER MARINE CORPS SYSTEMS COMMAND ATTN CBGT QUANTICO VA 22134-5080

NO. OF COPIES	ORGANIZATION
1	DIRECTOR AMC-FIELD ASSIST IN SCIENCE & TECHNOLOGY ATTN AMC-FAST (RICHARD FRANSEEN) FT BELVOIR VA 22060-5606
1	COMMANDER US ARMY FORCES COMMAND ATTN FCDJ SA BLDG 600 AMC FAST SCIENCE ADVISER FT MCPHERSON GA 30330-6000
1	COMMANDER I CORPS AND FORT LEWIS AMC FAST SCIENCE ADVISER ATTN AFZH CSS FORT LEWIS WA 98433-5000
1	HQ III CORPS & FORT HOOD OFFICE OF THE SCIENCE ADVISER ATTN AFZF CS SA FORT HOOD TX 76544-5056
1	COMMANDER U.S. ARMY NATL TRAINING CENTER AMC FAST SCIENCE ADVISER ATTN AMXLA SA FORT IRWIN CA 92310
1	COMMANDER HQ XVIII ABN CORPS & FORT BRAGG OFFICE OF THE SCI ADV BLDG 1-1621 ATTN AFZA GD FAST FORT BRAGG NC 28307-5000
1	SOUTHCOM WASHINGTON FIELD OFC 1919 SOUTH EADS ST SUITE L09 AMC FAST SCIENCE ADVISER ARLINGTON VA 22202
1	HQ US SPECIAL OPERATIONS CMD AMC FAST SCIENCE ADVISER ATTN SOSD MACDILL AIR FORCE BASE TAMPA FL 33608-0442
1	HQ US ARMY EUROPE AND 7TH ARMY ATTN AEAGX SA OFFICE OF THE SCIENCE ADVISER APO AE 09014
1	COMMANDER HQ 21ST THEATER ARMY AREA CMD AMC FAST SCIENCE ADVISER ATTN AERSA APO AE 09263

NO. OF COPIES	ORGANIZATION
1	COMMANDER HEADQUARTERS USEUCOM AMC FAST SCIENCE ADVISER UNIT 30400 BOX 138 APO AE 09128
1	HQ 7TH ARMY TRAINING COMMAND UNIT #28130 AMC FAST SCIENCE ADVISER ATTN AETT SA APO AE 09114
1	COMMANDER HHC SOUTHERN EUROPEAN TASK FORCE ATTN AESE SA BUILDING 98 AMC FAST SCIENCE ADVISER APO AE 09630
1	COMMANDER US ARMY PACIFIC AMC FAST SCIENCE ADVISER ATTN APSA FT SHAFTER HI 96858-5L00
1	COMMANDER US ARMY JAPAN/IX CORPS UNIT 45005 ATTN APAJ SA AMC FAST SCIENCE ADVISERS APO AP 96343-0054
1	AMC FAST SCIENCE ADVISERS PCS #303 BOX 45 CS-SO APO AP 96204-0045
1	COMMANDER ALASKAN COMMAND ATTN SCIENCE ADVISOR (MR GRILLS) 6-900 9TH ST STE 110 ELMENDORF AFB ALASKA 99506
1	CDR & DIR USAE WATERWAYS EXPERIMENTAL STATION ATTN CEWES IM MI R (A S CLARK) CD DEPT #1153 3909 HALLS FERRY ROAD VICKSBURG MS 39180-6199
1	MR GARY PERLMAN COMPUTER & INFORMATION SCIENCE OHIO STATE UNIV RM 228 BOLZ HALL 2036 NEIL AVENUE COLUMBUS OH 43210-1277

NO. OF COPIES	ORGANIZATION
1	DR SEHCHANG HAH DEPT OF BEHAVIORAL SCIENCES & LEADERSHIP BUILDING 601 ROOM 281 US MILITARY ACADEMY WEST POINT NEW YORK 10996-1784
1	US ARMY RESEARCH INSTITUTE ATTN PERI IK (DOROTHY L FINLEY) 2423 MORANDE STREET FORT KNOX KY 40121-5620
1	DENNIS SCHMIDT HQDA DAMO FDQ 400 ARMY PENTAGON WASHINGTON DC 20310-0460
1	US MILITARY ACADEMY MATHEMATICAL SCIENCES CENTER OF EXCELLENCE DEPT OF MATHEMATICAL SCIENCES ATTN MDN A MAJ DON ENGEN THAYER HALL WEST POINT NY 10996-1786
1	NAIC/DXLA 4180 WATSON WAY WRIGHT PATTERSON AFB OH 45433-5648
1	CECOM SP & TERRESTRIAL COM DIV ATTN AMSEL RD ST MC M H SOICHER FT MONMOUTH NJ 07703-5203
1	PRIN DPTY FOR TECH GY HDQ US ARMY MATL CMND ATTN AMCDCG T M FISETTE 5001 EISENHOWER AVE ALEXANDRIA VA 22333-0001
1	PRIN DPTY FOR ACQTN HDQ US ARMY MATL CMND ATTN AMCDCG A D ADAMS 5001 EISENHOWER AVE ALEXANDRIA VA 22333-0001
1	DPTY CG FOR RDE HDQ US ARMY MATL CMND ATTN AMCRD BG BEAUCHAMP 5001 EISENHOWER AVE ALEXANDRIA VA 22333-0001

NO. OF COPIES	ORGANIZATION
1	DPTY ASST SCY FOR RSRCH & TECH SARD-TT F MILTON RM 3E479 THE PENTAGON WASHINGTON DC 20310-0103
1	ODCSOPS D SCHMIDT WASHINGTON DC 20310-1001
1	OSD OUSD(A&T)/ODDDR&E(R) J LUPO THE PENTAGON WASHINGTON DC 20301-7100
1	ARL ELECTROMAG GROUP CAMPUS MAIL CODE F0250 A TUCKER UNIVERSITY OF TEXAS AUSTIN TX 78712
1	DUSD SPACE 1E765 J G MCNEFF 3900 DEFENSE PENTAGON WASHINGTON DC 20301-3900
1	USAASA MOAS-AI W PARRON 9325 GUNSTON RD STE N319 FT BELVOIR VA 22060-5582
1	CECOM PM GPS COL S YOUNG FT MONMOUTH NJ 07703
1	GPS JOINT PROG OFC DIR COL J CLAY 2435 VELA WAY STE 1613 LOS ANGELES AFB CA 90245-5500
1	ELECTRONIC SYSTEMS DIV DIR CECOM RDEC J NIEMELA FT MONMOUTH NJ 07703
3	DARPA L STOTTS J PENNELLA B KASPAR 3701 N FAIRFAX DR ARLINGTON VA 22203-1714
1	SPECIAL ASST TO THE WING CDR 50SW/CCX CAPT P H BERNSTEIN 300 O'MALLEY AVE STE 20 FALCON AFB CO 80912-3020

NO. OF COPIES	ORGANIZATION
1	USAF SMC/CED DMA/JPO M ISON 2435 VELA WAY STE 1613 LOS ANGELES AFB CA 90245-5500
1	ARL HRED USAADASCH FLD ELEMENT ATTN AMSRL HR ME (K REYNOLDS) ATTN ATSA CD 5800 CARTER ROAD FORT BLISS TX 79916-3802
1	ARL HRED ARDEC FIELD ELEMENT ATTN AMSRL HR MG (R SPINE) BUILDING 333 PICATINNY ARSENAL NJ 07806-5000
1	ARL HRED ARMC FIELD ELEMENT ATTN AMSRL HR MH (J JOHNSON) BLDG 1109B 3RD FLOOR FT KNOX KY 40121-5215
1	ARL HRED ATCOM FIELD ELEMENT ATTN AMSRL HR MI BLDG 105 1ST FLOOR POST A-7 4300 GOODFELLOW BLVD ST LOUIS MO 63120-1798
1	ARL HRED AVNC FIELD ELEMENT ATTN AMSRL HR MJ (R ARMSTRONG) PO BOX 620716 BLDG 514 FT RUCKER AL 36362-0716
1	ARL HRED FT BELVOIR FIELD ELEMENT ATTN AMSRL HR MK (P SCHOOL) 10109 GRIDLEY ROAD SUITE A102 FORT BELVOIR VA 22060-5850
1	ARL HRED CECOM FIELD ELEMENT ATTN AMSRL HR ML (J MARTIN) MYER CENTER RM 3C214 FT MONMOUTH NJ 07703-5630
1	ARL HRED FT HOOD FIELD ELEMENT ATTN AMSRL HR MV (E SMOOTZ) HQ TEXCOM BLDG 91012 RM 111 FT HOOD TX 76544-5065
1	ARL HRED MICOM FIELD ELEMENT ATTN AMSRL HR MO (T COOK) BUILDING 5400 ROOM C242 REDSTONE ARSENAL AL 35898-7290

NO. OF COPIES	ORGANIZATION
2	ARL HRED NATICK FIELD ELEMENT ATTN AMSRL HR MQ (M FLETCHER) ATTN SSCNC A (D SEARS) USASSCOM NRDEC BLDG 3 RM R-140 NATICK MA 01760-5015
1	ARL HRED SC&FG FIELD ELEMENT ATTN AMSRL HR MS (L BUCKALEW) SIGNAL TOWERS RM 207 FORT GORDON GA 30905-5233
1	ARL HRED TACOM FIELD ELEMENT ATTN AMSRL HR MU (M SINGAPORE) BLDG 200A 2ND FLOOR WARREN MI 48397-5000
1	ARL HRED STRICOM FIELD ELEMENT ATTN AMSRL HR MT (A GALBAVY) 12350 RESEARCH PARKWAY ORLANDO FL 32826-3276
1	ARL HRED USAIC FIELD ELEMENT ATTN AMSRL HR MW (E REDDEN) BLDG 4 ROOM 332 FT BENNING GA 31905-5400
1	ARL HRED USAFAS FIELD ELEMENT ATTN AMSRL HR MF (L PIERCE) BLDG 3040 RM 220 FORT SILL OK 73503-5600
1	ARL HRED USASOC FIELD ELEMENT ATTN AMSRL HR MN (F MALKIN) HQ USASOC BLDG E2929 FORT BRAGG NC 28307-5000
1	ARL HRED FT LEAVENWORTH FLD ELE ATTN AMSRL HR MP (D UNGVARSKY) TPIO ABCS 415 SHERMAN AVE RM 327 FT LEAVENWORTH KS 66027-1344
1	ARL HRED FT HUACHUCA FLD ELEMENT ATTN AMSRL HR MY (B KNAPP) GREELY HALL (BLDG 61801 RM 2631) FORT HUACHUCA AZ 85613-5000
1	ARL HRED OPTEC FIELD ELEMENT ATTN AMSRL HR MR (D HEADLEY) PARK CENTER IV RM 1450 4501 FORD AVENUE ALEXANDRIA VA 22302-1458

NO. OF COPIES	ORGANIZATION
1	US ARMY RSCH DEV STDZN GP-UK ATTN DR MICHAEL H STRUB PSC 802 BOX 15 FPO AE 09499-1500
1	CDR SPEC COM REQ DIV ATTN JOHN DADE NAVAL AVIATION WARFARE CENTER AIRCRAFT DIV PATUXENT RIVER B-9 VILLA ROAD ST INIGOES MD 20684-0010
3	CDR USASOC ATTN AORI SI (CW3 GRAYBILL) BLDG E2929 FORT BRAGG NC 28307
	ABERDEEN PROVING GROUND
2	DIRECTOR US ARMY RESEARCH LABORATORY ATTN AMSRL CI LP (TECH LIB) BLDG 305 APG AA
1	LIBRARY ARL BLDG 459 APG-AA
1	ARL SLAD ATTN AMSRL BS (DR JT KLOPCIC) BLDG 328 APG-AA
1	USMC LIAISON OFFICE ATTN AMST ML RYAN BUILDING APG-AA
1	USATECOM RYAN BUILDING APG-AA
1	COMMANDER CHEMICAL BIOLOGICAL AND DEFENSE COMMAND ATTN AMSCB CI APG-EA
1	ARL HRED ERDEC FIELD ELEMENT ATTN AMSRL HR MM (D HARRAH) BLDG 459 APG-AA

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. AGENCY USE ONLY *(Leave blank)*	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	November 1997	Final

4. TITLE AND SUBTITLE

Joint Base Station Variant 1 MOS-Workload-Skill Requirements Analysis

5. FUNDING NUMBERS

AMS: 622716.H700011
PR: 1L161102B74A
PE: 6.11.02

6. AUTHOR(S)

Malkin, F.J.; Allender, L.E.; Kelley, T.D. (ARL) ; O'Brien, P.; Graybill, S. (USASOC)

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)

U.S. Army Research Laboratory
Human Research & Engineering Directorate
Aberdeen Proving Ground, MD 21005-5425

8. PERFORMING ORGANIZATION REPORT NUMBER

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)

U.S. Army Research Laboratory
Human Research & Engineering Directorate
Aberdeen Proving Ground, MD 21005-5425

10. SPONSORING/MONITORING AGENCY REPORT NUMBER

ARL-TR-1441

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION/AVAILABILITY STATEMENT

Approved for public release; distribution is unlimited.

12b. DISTRIBUTION CODE

13. ABSTRACT *(Maximum 200 words)*

The U.S. Army Special Operations Command is developing a replacement communications base station known as the Joint Base Station Variant 1 (JBS V1). The JBS (V1) incorporates an automation subsystem not found in predecessor systems. The introduction of the automation subsystem raised concerns about its impact on the military occupational specialty (MOS) and quantity of base station operators. Task analysis and modeling using the Improved Performance Research Integration Tool (IMPRINT) were conducted to assess skill requirements, workload, and mission performance to assist in determining the appropriate quantity and MOS of JBS (V1) operators. The outcome of the analysis predicts that one Special Forces Communications Sergeant MOS 18E, one Record Telecommunications Operator MOS 74C, and one Information Systems Operator-Analyst MOS 74B are an appropriate skill mix to successfully operate the JBS (V1) during a 12-hour shift. With the implementation of this crew complement plus one 18E supervisor, it would be possible for the Base Station Section of the Special Forces Battalion Signal Detachment to be reduced from the current total number of eight to seven personnel.

14. SUBJECT TERMS

manpower; skill requirements; workload
perosnnel; telecommunications

15. NUMBER OF PAGES

75

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
Unclassified	Unclassified	Unclassified	

NSN 7540-01-280-5500

Standard Form 298 (Rev. 2-89)
Prescribed by ANSI Std. Z39-18
298-102